PRACTICAL KERAMICS

FOR STUDENTS

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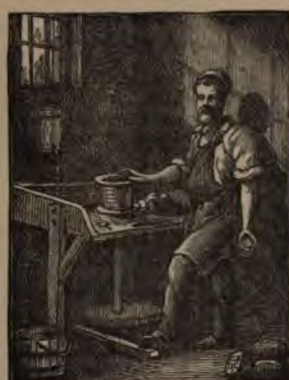
BY

CHARLES A. JANVIER



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PREFACE.

In preparing this little book, the authorities principally consulted are Brongniart, Salvétat, Ebelmen, Roscoe, Jewett, Shaw, Binns, Stanislas Julien's tranlation of a Chinese work, Zeigler, Jacquemart, Marryat, Birch, besides various reports and articles in technical and other reviews and journals. I am also indebted to several potters and decorators for valuable information.

I have endeavored to give in as small a compass as possible a clear account of the manufacture and decoration of pottery of all kinds, and even at the risk of repetition have tried to be perfectly clear; always endeavoring to imagine myself explaining the various processes to persons utterly ignorant of the subject. Any such persons, if desirous of knowing more, will find the names given of the principal works on pottery. No illustrations of machinery, firing apparatus, etc., are given, because they could not be made thorough enough to be of use to potters, and few others could understand the working drawings which can be found in full in some of the works cited. I have endeavored most fully to describe the wares that seem to have the most general interest, and in regard to classification have sought to remove the confusion I have observed existing in the minds of many persons, trying to make all definitions so clear that any one can at once put any ware in its proper place, without regarding the utterly incorrect names often given by shop-keepers and others. As there are so many excellent and easily obtained histories of pottery, I have only glanced at this part of the subject; as also at the very interesting part relating to ancient and mediæval pottery. I have not touched at all on marks and rules for collectors, a *little* information on this subject being useless. I have given fuller details in regard to modern pottery, particularly porcelains, the so-called Limoges wares, and Chinese and Japanese porcelains, trying to bring together information that is scattered through many works, often difficult to obtain or consult. The chemical and other scientific terms, being intended for persons having little or no acquaintance with science, are those in every-day use, no attempt having been made to keep to the perfectly correct nomenclature.

I think that persons intending to paint or otherwise decorate pottery will do well to read with attention all the first part of the book, as some slight knowledge of pastes, glazes and baking is requisite in order to do good work. To do the best work, particularly in this country, a very thorough knowledge of these is necessary, which knowledge can be obtained only by careful study, observation and comparison. In the chapter on keramic painting I have said much that may appear very trite to those well acquainted with the subject, but which will be of service to beginners, and above all to those living far from city facilities. It might indeed seem that an undue prominence has here been given to decoration, but besides the fact that this is usually considered the most interesting part of the subject, it should be borne in mind that decoration is not only æsthetically but commercially of great importance. Of two jugs, both equally well adapted to their purpose, the prettiest or the most agreeable will have by far the largest sale. Such things are generally bought by women, naturally the ultimate buyers of household ware, and women notice, often unconsciously, this difference, the ignorant wife of the poorest workman preferring the jug with the softest color and the brightest glaze to a jug perhaps better made but ugly and dull.

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PART I.

INTRODUCTORY.

CHAPTER I.

NOMENCLATURE.

Pottery.—A pot is a vessel intended to hold something. A potter is a man who makes pots of clayey or rocky materials, which are afterwards either sun-dried or fire-baked. Pottery means all that is made by the potter, the term being extended to include not only all kinds of pots, but even such things as ornaments, flat plaques, statuettes, or bas-reliefs. The term pottery is often used in a restricted sense, and applied only to common earthenware or crockery, and sometimes to crockery and fine earthenware together.

Keramics or **Ceramics.**—The derivation of this word is essentially the same as that of pottery, being from the Greek for horn, the first drinking-vessel. Later, drinking-horns were made in clay or metal. The Keramicus was the potters' quarter in Athens.

Brongniart and Salvétat both suggest that the general term should be keramics, or the keramic arts, pottery then falling into its place as one of them. The whole nomenclature is unsettled, particularly in books written in English. Each author has his favorite set of terms, making it puzzling for the novice. Leaving the settlement of this matter to wise men, it is only necessary to state that in this book the term pottery includes all terra-cottas, earthenwares (faïences), stonewares and porcelains. Further on, with the description of the different wares, are given Brongniart's full table of classification, which is the one generally used, and also Salvetat's, which is more complete, and which if adopted generally, would do away with the confusion at present existing.

Potting.—When we speak of a vessel being well *potted*, we mean that the difficulties of manufacture are well overcome. By a potter is generally meant the man who does only the mechanical part of the work, which is subsequently ornamented by the decorator. The word **Keramist** would seem to include both these terms, and it is often very convenient. Such men as Deck and Haviland call themselves **Céramistes.**

Refractory.—Difficult to melt or fuse.

Hard.—Means difficult to fuse; also that a piece of pottery cannot be scratched by a steel point.

Soft.—Fusible—also, can be scratched by a knife or steel point.

Flux.—Certain infusible substances can be made fusible by the addition of other substances, called fluxes, not necessarily fusible in themselves. Salvetat says, "It is a priori difficult to form a perfectly clear idea of the causes of the fusibility which is often developed by the combination of infusible substances. Certain infusible clays become fusible enough to liquefy when mixed with lime, which in itself is very refractory."

Craze.—Cracking of the glaze or paint.

Biscuit.—Ware before it is glazed.

China.—An indefinite name generally meaning porcelain.

Terra-Cotta.—Baked or fired clay.

Pitchers—Or ground pitchers—Baked ware finely pulverized (Fr. *ciment*).

Plumbiferous.—With lead.

Stanniferous.—With tin.

Gloss-oven.—Kiln in which glazes are baked.

Medium.—Anything with which pigments are mixed for painting, such as turpentine, water, etc.

Fat-oil.—Thick turpentine, often called oil.

Slip.—Diluted paste—a thin layer of paste.

Barbotine.—Thin slip.

Céladon.—A delicate greenish blue, also used as the name of a glaze on Eastern porcelain.

Rouge flammé—Or flambé.—A peculiar red, derived from copper and variegated with bluish tones.

Pâte-changeante.—A ware or rather glaze which is grey by daylight and rosy at night.

Camaïeu.—(decoration) A monochrome—sometimes a painting in only two colors.

Marly.—The flat border of a plate.

Engobe.—A thin layer of paste—a slip.

Ciment.—Often incorrectly translated cement. See pitchers.

The French words given above are often found in English books on pottery.

For convenience, and in order fully to understand the following description of materials and manufactures, it is well to remember that all pottery can be divided into two classes; first, **Earthenware** (Fr., *faïence*), which ranges from the common flower-pot to the fine white table-ware such as that miscalled *porcelaine opaque;* the characteristics of all ware of this first class being that the body of the ware is *dull* and *opaque*, *porous*, and *adheres* to the *tongue*. It is generally glazed for use, and in the coarse earthenwares the colored body either shows through the transparent glaze, or the glaze is colored, or else is rendered opaque so as to hide the coarse body, or else a layer of finer clay is placed on the body before the glaze is applied. The body itself can be made finer and whiter, and then the necessity of hiding it vanishes, and the glaze is made transparent. A common flower-pot, or a dish of the commonest crockery, and a piece of granite-ware, or of the *porcelaine opaque* made by Bridgwood, or of any other fine earthenware (Fr., *faïence fine*), are easily procured examples of the two extremes of this ware. When the coarse body is covered by a *glaze rendered opaque* and *white* by *tin*, and *ornamented* on that, it is generally known as **Majolica.**

The second class is composed of **Porcelain** and

Stoneware. In these the body of the ware is *impervious*, and does *not* cling to the tongue. The stoneware may vary in quality from the common butter-pots to the fine Doulton ware. Porcelain has the same characteristics as stoneware, only it is translucent. Stoneware may be considered an inferior porcelain. Both wares when glazed have an intensely hard glaze, but being *impervious to moisture* could be used without any glaze at all. Porcelain and stoneware are baked at a much greater heat than the earthenwares, though in some of the finer earthenwares now made the heat is great, and there is an almost imperceptible gradation from one kind of ware to the other. Some broken pieces of the above mentioned wares, and a careful comparison of one with another, will teach any one far more than any description. In all ware belonging to the first class, the glaze will be seen to be entirely distinct from the body. In the second class it will seem to be incorporated with the body, particularly in the case of French and Chinese porcelains and all stoneware. *No opaque ware can be a true porcelain.*

CHAPTER II.

HISTORICAL SKETCH.

IT is impossible to assign the **Origin of Pottery** to any age or to any people. We can indeed study much of its development in our cotemporaries, for there are many savage tribes making now, and having in common use, much such pottery as is found in prehistoric mounds, and in the lake dwellings, and from them we can run up the scale to the richest majolicas and to the delicate egg-shell porcelain of Japan.

Vessels of sun-dried pottery probably in most cases preceded those baked in the fire, though this is not necessarily the case.

But if many men may be regarded as having had a part in the beginning of pottery, three countries may claim the honor in the East and in the West of raising a rude craft to an art. Whether the art originally began in one, and was communicated to the others, or whether it arose independently in the several centres, we know not as yet; but 4000 years ago **China**, **Babylonia**, and **Egypt** were great *keramic centres*, and of these three it now seems probable that Babylonia may take the precedence. Many circumstances give reason to think that the art spread eastward and westward from this great centre, but this and analogous questions are not yet settled. It is positively known, however, that good pottery was made in these countries about the date mentioned, whence it must be inferred either that they had received the art from preceding nations, or else that in the course of time they had slowly acquired the knowledge. Chinese traditions affirm that pottery was so much of a science, and was so well reduced to a system, that there was an inspector or superintendent of pottery long before 2000 B. C. In 2255 B. C. pottery was manufactured in a place near the present district of Thing Thao. From that time until 202 B. C. only earthenware, not porcelain, was made. As far as *porcelain* is concerned, there seems no doubt at all of the claim of the Chinese to its invention. The Babylonians certainly made good pottery 4000 years ago, and we do not know how much longer beforehand. In later, but still very remote times, they and the Assyrians made excellent pottery with a fine colored silico-alkali glaze, often so thick as to seem an enamel. This knowledge was still later transmitted to the Persians, and from them to the Arabs, and thence in turn to the Europeans: so Lucca della Robbia may be a keramic descendant in an unbroken line of a potter cotemporaneous with Abraham, or even perhaps with Noah.

On the other hand, although the Egyptians were not as good potters as the Babylonians, the art may have originated in Egypt, where, from the paintings on the Beni Hassan tombs, we know it was flourishing 4000 years ago. It may have been carried into **Assyria** and **Phœnicia.** In those remote times there was probably more communication among countries than we are accustomed to think, and in time the knowledge of various crafts most likely spread slowly in every direction from different centres, the waves crossing and intermingling, so that now it is often impossible to trace out their origin. The Egyptians also understood the making of *fine colored glazes.* Much of their work is very beautiful and shows great artistic feeling and good technical knowledge. As time went on, the influence of both Egypt and Assyria in all probability swamped and overwhelmed the aboriginal art of **Asia Minor,** though relics of it survived and often flourished in out-of-the-way corners. Much pottery is found in Asia Minor with the fine glazes in which both of the above-mentioned countries excelled.

Greek potters, and the potters influenced by them in Magna Græcia and elsewhere, seem to have felt the influence of both Egypt and Assyria, but in their best art pottery, the Greeks, with their usual good taste, borrowed what suited them, transformed what often was stiff or grotesque, and, adding it to their own conceptions, created pottery which, so far as concerns purity of form, grace and beauty of design and decoration, is the finest the world has ever seen. Their technical knowledge, too, was excellent as far as it went; though they never made anything but what we call coarse earthenware, most of it being friable, very porous, and baked at a low temperature. Apparently they did not choose to do more, for it seems incredible that, with their intercourse with the Egyptains and Persians, they should not have known about their various colored glazes; but they certainly never adopted them, except perhaps in the case of the hard glaze on lustrous ware, which was also a silico-alkali glaze, and which they may have invented themselves. There is no trace of lead or tin in any of these very old glazes. The great period of Greek keramic art lasted nearly seven or eight centuries, its culminating point being about 400 B. C. From that time it slowly declined, and was practically lost in **Roman Art,** which may be considered as an extension and generally a degradation of Greek art. For a long time everything Greek was very fashionable in Rome.

About the century preceding our era, the Romans arrived at the creation of an artistic pottery, distinctively their own: the *Terra Sigillata,* also called Samian ware, after the Greek ware formerly made at Samos. The finest of this was made at Arezzo in Etruria, and was the prototype of ware found wherever the Romans carried their power. And so the knowledge of making pottery after the Greco-Roman fashion spread all over the Roman Empire, and in the early part of the Christian era, replaced, in Europe, the primitive potteries of the half-savage tribes of Gaul, Britain and other countries.

With the fall of the Roman Empire, pottery as an art seemed to disappear, and through the dark ages succeeding languished with all other arts. To this dark time belong many rude potteries, utterly uninteresting save as evidences of the constant existence of the instinctive ability to mould and fashion clay. Much of this pottery still shows faint traces of Roman influence, and the excellent Roman methods and traditions seem to have kept up a precarious existence in some few places. Fine keramic art did not reappear for years, and then again came from the East through the Arabs or the Saracens, who had preserved many of the traditions of the old Persian potters. In this revival **Spain** and **Majorca** seem to have been the great centres, but sporadic potteries are found in various places which may have been either the survivors of old potteries or else places to which independent knowledge had been brought from the East; for with the East there seems always to have existed a certain amount of intercourse, even in the dark ages.

It was probably through Spain, in the early time of the Moorish occupation, that the first new art ideas found their way into the rest of Europe, and these may have been strengthened by the few traditions left of Roman methods. The origin of the lead-glaze seems very uncertain, but no doubt it arose naturally from the old silico-alkaline glaze, into which, first a little, and then more, lead, and afterwards tin, was introduced. The oldest tin-glazes seem to come from Persia through the Arabs, who were good chemists for those days. By the beginning of the eighth century the Spanish, or rather the Moorish wares of Spain, had grown famous, and offshoots of these potteries were flourishing in Majorca and other places. These potters were the first to show to Europe the beautiful opaque tin-glaze destined to work such a revolution in pottery, and which we have reason to think was used in Germany as early as 1283. Still later, the beautiful products brought from the East, both through Venice, and afterwards by the Portuguese, aroused the emulation of the European potters, who, struggling and striving, seem to have succeeded in many cases in obtaining the same results in several different and isolated places. **Lucca della Robbia** perfected the ware to which he gave his name, and which for a time was the art pottery of the world. About the same date **Palissy** was struggling blindly to obtain the white tin enamel, which at the very same time was being used by one of the della Robbias in Paris, and by Masseot d' Abaquesne at Rouen. About this time too, the delicate **Oiron** earthenware was created by a woman's taste. In Germany some time previous stoneware had made its appearance, and by the end of the 16th century had reached its perfection. During this time England had lagged behind the rest of

Europe. In **Staffordshire** coarse pottery had been made from very early times. Beginning at Burslem with the Elers, and descending through Astbury and Wedgwood to the Mintons and Doultons of our own day, the improvement has been steady.

While Europe was bringing earthenware and stoneware to perfection, Asia had long been in possession of the art of porcelain making. According to the Chinese tradition, porcelain was first made at **Sin-Ping,** in 185 B.C. The celebrated porcelain factories at **King-te-Chin** were established 538 A. D. and from that time were in full activity, while many less important places started up. **India** and **Persia** too, unquestionably made porcelain at a very early period. The **Japanese,** according to their own authorities, derived the art from the Chinese, making first a kind of stoneware (1223). In the 16th century porcelain was first made at **Hizen** under the direction of Gorodayu Shonsui, who went to China in order to learn, while about the same time several porcelain makers were brought over from the Corea by Prince Nabesshima Naoshige.

Eastern porcelain certainly found its way into Europe about 1500, and it very probably was brought there even sooner. Many curious attempts were made by European potters to reproduce it, but for a long time their attempts were in vain. Some of these attempts bore important fruit. Soft porcelain was successfully made, and according to the latest discoveries, the *very first* porcelain made in Europe was in **Venice**, there being in the archives a letter, dated 1470, from Uielmo da Bologna, that seems conclusively to prove this fact. Soft porcelain was next made in **Tuscany**, near the end of the 16th century, under the auspices of the Grand Duke, Francis I., but the art was lost; to be revived again in **France** about 1695. Then the chemist Böttcher, after many trials, succeeded in producing a true hard porcelain at **Meissen**, near Dresden, in 1709, and though great efforts were made to keep it secret, the art spread thence over Europe, and from Europe to America.

In **England** for a time soft porcelain was made, differing but little from that made elsewhere, but about 1800 Josiah Spode created or rather perfected what was practically a new ware, the bone phosphate porcelain, the only kind now made in England. Since that time potters have been employed in improving the manufacture of all the different wares.

TABLE OF SOME

B. C.	KIND OF POTTERY.	COUNTRIES.
2698.........		China....................
2255.........	Earthenware....................	China....................
2000.........	Earthenware....................	China....................
2000.........	Earthenware....................	Babylonia................
1900.........	Earthenware....................	Egypt... ....
1500.........	" soft...............	Greece................
1200.........	" "	" ....
900 to 907	" "	Greece, Samos.......
658.........	" "	Italo-Greece............
592.........	" "	Athens..................
538.........	" perhaps stoneware	China....................
507........	Earthenware soft........	Etruria..................
500.........	....	Cyrene ....
434.........	....	Italo-Greece............
202.........	Porcelain	China....................
185.........	Porcelain....	China....................
29.........	Earthenware....................	Japan....................

IMPORTANT DATES.

REMARKS.	AUTHORITIES.
Rather apocryphal, even according to Chinese authorities....	From Stanislas Julien's Hist. et Fabrication de la Porcelaine.
According to the unanimous opinion of the best Chinese authority only earthenware was made until 202 B. C....	
All these dates are only approximate. The quality of the ware proves previous experience. Silico-alkali glazes, no lead nor tin....	Smith's Assyria.
Brogniart says the Egyptians were better glass-makers than potters, whence their fine colored glazes. The body is often very hard and infusible, more like sandstone than pottery....	Beni-Hassan tombs and relics.
Chœrebus is said to have invented pottery, and Talus the wheel. Such statements must never be taken literally without the most ample proof....	Greek tradition.
The Samian potters were very famous. The best Greek wares were lustrous—and this lustre was superior to the Egyptian glaze though much like it in composition. It was hard, and not affected by acids nor alkalies.	Life of Homer, attributed to Herodotus. See Brogniart.
Thurianus—vase of the boar-hunt. Capua—Campanian, or Italo-Greek, sometimes incorrectly called Etruscan....	d'Hancarville. See Brogniart.
Anacharsis, the Scythian, said to have perfected the potter's wheel....	Jacquemart.
Establishment of the great potteries at King-te-chin. No porcelain as yet....	Hist. et Fab.
It is said that Porsenna had a table service of pottery. The Etruscans certainly used pottery for many domestic purposes. Some Etruscan pottery seems to have imitated the Greek wares.	d'Hancarville. See Brogniart, also Birch, Jacquemart, etc.
The cup of Archesilaus, probably anterior to this date, found at Vulci, Etruria. The Cumean vase at St. Petersburg is also about this date. In this last the decoration is in relief, richly colored and gilded....	See Brogniart for full account.
In Campania were made vases afterwards classed as Tyrian or Tyrio-Phenician. Many authorities think there were potteries on the Greek methods established in many places. Pottery more or less alike, and evidently made by the same recipes, extended from the sea of Azof to Cyrenaica in Africa, and Sicily in Europe, and was made during 1250 years, ceasing entirely about 350 A. D. No other fine pottery was made in Europe....	
Chinese tradition says the first porcelain, probably a fine stoneware, was made—Han dynasty	Hist. et Fab.
Porcelain certainly was invented between this and 87 A. D....	
Emperor Suiniu—clay figures burned in ovens. Tradition says pottery was invented in pre-historic times, by Ooseitsumi. In the reign of Jimnu, 660 B. C. pottery is said to have been made in Japan....	Japanese Catalogue.

TABLE OF SOME

B. C.	KIND OF POTTERY.	COUNTRIES.
Before the year 1	Earthenware, very soft	France, Germany; England, Denmark
No certain dates	Earthenware, hard	America: Mexico, Guatamala, Copan, and elsewhere.
A. D.		
150	Earthenware, lustrous, hard; Earthenware, soft and hard	Italy, Gaul and Britain
711 to 780	Earthenware	Arabia, Persia
724		Japan, Yamato
960	Porcelain, stoneware, earthenware	China
1000	Porcelain, fritted	Persia
1074 to 1088	Earthenware	Italy, Pesaro
1100	Porcelain hard	Persia
1100 to 1146	Earthenware	Arabian
	Earthenware	Armenia
1207	Earthenware	Leipsig
1223-33	Porcelain, hard and fritted	India
1282	Earthenware, soft	Alsatia
1279	Porcelain (crackled)	China
1290	Earthenware	Breslau Silesia
1300	Earthenware	

IMPORTANT DATES.—*Continued.*

REMARKS.	AUTHORITIES.
These potteries vary greatly in quality and decoration, but are the primitive potteries of the countries in which they are found. The list could be extended. No certain dates.	
A fine pottery with silico-alkali glaze, resembling the Roman and Greek lustre. The date is unknown. Remarkable pottery has been found in Peru and in Central America, some of it very fine. It must be remembered that pre-historic is not necessarily primitive nor rude pottery..................................	See Brogniart, Birch Jacquemart, etc.
Terra-sigillata. Hard, red, lustrous, very well made, with ornaments in relief. Also a coarser ware. This, in Europe, gradually superseded the primitive potteries. For a long time after this, we have no keramic records whatever..........................	
Most dates uncertain. Little or no lead in glaze. Glazed generally with a sort of silico-alkali glass, like the lustres.........................	
Potter's wheel introduced by Giyoki. Specimens of ware of that epoch still exist in temple of Todaiji......................	Japanese Catalogue.
Lead-glaze in common use. May possibly have spread westward............................	Jacquemart.
Jacquemart says the first Persian porcelains are of about this date..........................	
Here seems to have been made the first lead-glaze used in Europe. At first it seems to have been used as an ornament. Probably derived from the East.....................	Jacquemart. See also Brogniart, Demmin, Salvétat, and others.
Jacquemart says about this date hard porcelain was made in Persia.........................	
Glazed, see below. All these are tiles or pavements. Found in various places.............	
Lead-glazes were used all through the East before this date. They seem gradually to have grown out of the silico-alkali glaze, the oldest known. A little lead seems to have been added, and afterwards a regular lead-glaze made, and this was followed by the tin-glaze. The question will soon be definitely settled...	
Glazed frieze said to be of this date. May be an independent creation. There were good glass-makers in Germany....................	
Fine porcelains. Remarkably good in decoration. Dates very uncertain..................	
Lead-glaze said to have been used by a Schlestad potter. Also before this at Jumiéges. May have learned from the Italians............ ..	Jacquemart and other authorities. Articles in Gazette des Beaux Arts, and in other perodicals. [No further authorities will be given, except for some especial ware.]
....	
Tomb of Henry IV. lead-glazed...............	
It is claimed that the above and much other German pottery was made antedating the French and Italian, and growing up as an independent centre. It is all a little uncertain.	

TABLE OF SOME

A. D.	KIND OF POTTERY.	COUNTRIES.
1300.........	Earthenware soft..............	Spain..................
1300.........	" soft and hard.....	Persia....................
1300.........	Earthenware, soft.............	Italy, Pesaro............
1415.........	Earthenware (majolica)........	Italy, Florence...........
1441–70......	Earthenware (majolica)........	Nuremberg.............
1470	Porcelain (fritted)............	Venice..................
1508.........	Porcelain, Chinese, hard.......	Europe..................
1511 to 1540	Earthenware (majolica)........	Italy, Pesaro............
1540.........	Stoneware (grès de Flandre)...	Cologne, Nuremberg..
....	" "	Buntzlau, Creussen....
1540.........	Stoneware....................	France, Beauvais........
1547.........	Oiron earthenware or faïence..	France..................
1555	Earthenware (Palissy).........	France..................
1573.........	Porcelain (eggshell ware)......	China....................
1580 to 1590	Porcelain	Japan....................
1581.........	Porcelain (fritted).............	Tuscany..................
1592.........	Porcelain	Japan....................
1600.........	Earthenware (faïence).........	Holland, Delft...........

IMPORTANT DATES.—*Continued.*

REMARKS.	AUTHORITIES.
Tin and lead-glazed. Made by Spanish Moors before this date. May have influenced the above	
Tin-glazes very fine. Also silico-alkali on pretty hard body	
Mezza-majolica—scraffito ware—lead-glazed and often with lustres..........................	
Lucca della Robbia introduced the tin-glazed ware now bearing his name....	
Veit Hirschvogel and son are said to have made fine ware at this date. Jacquemart does not think so.....	
First indication of porcelain in Europe, no doubt an imitation of Eastern porcelain. Letter from Uielmo da Bologna in Venetian archives. No results......................	Gazette des Beaux Arts, 1879.
About this time the Portuguese began bringing porcelain to Europe.	
Orazio and Flaminio Fontana. About 1560 artistic earthenware began to fall off in beauty, and soon after became of little artistic value, though various efforts were made to revive it.........................	
Fine stonewares, often with ornaments in relief, generally salt-glazed. Lasted in full beauty until about 1615, then fell off. Said to have been invented before 1424—doubtful.	
Jacquemart thinks stoneware was made in the Beauvoisis long before 1540.................	
Often called Faïence Henri II. For description and history see Chapter X..................	Benj. Fillon.
Bernard Palissy succeeded in making the ware called after him. His art died with him. The paste is hard, sometimes very hard. The enamel is never pure white, like Lucca della Robbia's, nor like the Nevers majolica	
Gorodayu Shonsui went to China and learned the art. About the beginning of the 16th century raku ware (a black earthenware, lead-glazed), was introduced by Ameya from the Corea....	Japanese Catalogue.
Made for the Grand Duke Francis de Medici. Vasari says Bernardo Buontalenti was the potter. This porcelain still exists. It is not very fine in quality. It had no results.......	
Corean porcelain-makers brought to Hizen by Prince Nabeshima Naoshige. Prince Shimadzu Yoshihisa about the same date brought porcelain-makers to Satsuma.................	Japanese Catalogue.
It is claimed that the manufacture began about 1500. Very fine, both for tin-glaze and decoration................................	Numerous authorities.

TABLE OF SOME

A. D.	KIND OF POTTERY.	COUNTRIES.
1603	Earthenware	France, Sèvres
1671	Porcelain, fritted	England, Fulham
1695	Porcelain, fritted	France, St. Cloud
1706	Porcelain, hard	Saxony
1725	Earthenware, fine (flint body)	England
1735	Porcelain, (magnesia or hybrid)	Italy
1741	Porcelain, fritted	France
1740 to 1751	Porcelain, fritted	England, Chelsea England, Worcester
1760	Porcelain, hard	England, Plymouth
1763	Earthenware, fine	England, Staffordshire
1769	Porcelain	United States
1765 to 1770	Porcelain, hard	France, Sèvres
1796	Earthenware, stoneware	U. S., Norwich, Conn.
1800	Porcelain, bone-phosphate	England
1805		France, Sèvres
1825	Porcelain, hard	U. S., Philadelphia

IMPORTANT DATES.—*Continued.*

REMARKS.	AUTHORITIES.
From this time until about 1688 the faience or tin-glazed earthenwares of Rouen, Nevers St. Cloud, and other places were very famous, as were many others. The artistic pottery ceased about 1700, though some little was still made....	
By Dr. Dwight, but it was not until 1740 that the business took root in England............	
First fabric, tolerably fine. Effort to imitate hard porcelain	
Böttscher and Tschirnhaus first discovered kaolin hard porcelain. In spite of efforts to keep it secret, the knowledge gradually spread all over Europe. The proper clay was found in many places........	
Astbury in England invented or perfected the use of calcined flints in the paste, making practically a new ware..........	
Porcelain was made with magnesite. Very tough. No important results..........	
At Vincennes, thence transferred to Sèvres, 1756 Called second fabric. Very fine	
These porcelains were at first made by introducing flint glass into a paste resembling that of fine earthenware. Afterwards calcined bones were used. Lead-glaze, at first very soft..........	
Wm. Cookworthy made genuine hard porcelain. Commercially a failure..........	
About this date Wedgwood made his queensware and stoneware, and also then and afterwards introduced great improvements.......	
There seems to have been an attempt to start a bone porcelain pottery in Philadelphia, Pa. This porcelain was not perfected in England until later....	Prime, Elliott.
Good kaolin was discovered at St. Yrieix, near Limoges. Since that time hard porcelain has been made. At first the glaze had lime in it. Of late years it has been made of pegmatite..........	
It is difficult to find records of early potteries in the United States. Other potteries were probably in existence..........	History of Norwich, by Miss Caulkins.
Josiah Spode perfected the process of making English porcelain, the peculiarity of which is the use of phosphate of lime from bones.....	
Brogniart discontinued the manufacture of fritted (soft) body porcelain..........	
Wm. Ellis Tucker first seriously attempted porcelain-making in this country. Body and glaze good and hard. Workmanship and decoration poor. Corner Schuylkill Front and Chestnut Sts. Ceased about 1837..........	Letter from Thomas Tucker.

TABLE OF SOME

A. D.	KIND OF POTTERY.	COUNTRIES.
1830........	Earthenware fine..............	Europe and America.....
1847.........	Porcelain fritted................	France, Sèvres...........
1859.........	Porcelain (decoration)..........	" " ....
1861.........		
1873.........	Porcelain (decoration)..........	France....................

IMPORTANT DATES.—*Continued.*

REMARKS.	AUTHORITIES.
Dating from about this time great improvements have been made in paste and glaze. Kaolin, feldspar, etc., are used in the paste; borax, boric acid, and feldspar in glazes............	
The manufacture of fritted or soft body porcelain renewed at Sèvres......................	
Peinture a demi-grand feu, mèthode Richard. See Chapter VIII......................... ...	
Invention of method of compressing paste in moulds by means of compressed air.........	
Méthode Laurin, still further developed by the Havilands at Limoges. First application on a large scale of slip-painting to decorative earthenware. Many experiments in much the same style of decoration had been previously made. Slip-painting on porcelain, (pâte-sur-pâte) first tried by M. Riocreux, at Sèvres, in imitation of Chinese and Japanese methods...	

CHAPTER III.

POTTERY MATERIALS.

CLAYS.

WITH but few exceptions all pottery is made of clay, either in its natural state or modified by man.

Clays of various kinds are found all over the world. Several varieties soften in water, and become *plastic*, that is, will form a non-elastic, soft, tenacious paste that will retain any impression made on it, and that can also be made into moulds. The clays used by potters are of this nature, and are white, yellowish-white, grey, greenish, reddish, and occasionally black. This last color is generally produced by organic matters which frequently burn out of the clay when baked, leaving it perfectly white. The reddish and yellowish tints are caused by the oxides of iron. Many rocks contain a great deal of feldspar, of which the principal constituents are *alumina* and *silica* (also soda and potash, one or the other predominating.—See table, page 34). These rocks when worn down, disintegrated, and even decomposed by the action of the weather, and by other causes, make beds of clay more or less firm and compact. Sometimes this clay is washed away and settles down far from the original rock, gathering all sorts of impurities on the road; sometimes it remains associated with the rock, and then consists of a clay more or less pure, according to the nature of the primitive rock, and according to the circumstances which have accompanied its alteration.

The chief and characteristic constituent of all clays is the *hydrous silicate* of *alumina* (called kaolinite), associated with which there is always a considerable quantity of quartz sand or alkaline silicate, and many other matters. In other and less scientific terms, the indispensable ingredients in the composition of clay, are silica and alumina combined together, and with water, and this may be taken as a typical clay, and all clays as they depart from this ideal standard become less pure.

Silica and alumina alone are infusible at the highest heat of the potter's kiln, and in order to melt or soften must be mixed with a *flux* of some kind, such as the *alkalies*, *soda*, and *potash*, or with *oxides*.

The principal **Impurities** of clays are the *oxides of iron*, *lime*, *magnesia*, *the alkalies*, and sometimes a small amount of *iron pyrites* (sulphur and iron), of *titanic* and of *phosphoric acid*. The presence of these in considerable quantities renders a clay incapable of withstanding a high temperature without fusing; therefore some clays are very fusible, others refractory. By refractory, or infusible, is meant here that a clay will not melt in the extreme heat of the potter's kiln, say 1600° to 1800° Cent., 2912° to 3272° F., or about the melting point of wrought iron. All clay at a sufficient heat would melt into a sort of glassy substance.

The more alumina there is in a clay, the more *refractory* it is. At the same time, of two clays, both containing the same amount of alumina, one may be much more fusible than the other, owing to the proportions of the *fluxes* and of the *silica* in it. As a general rule, clays having the same proportions of aluminous and silicious elements possess an equal power of resisting extreme heat. Many substances are added by the potter to make the clay more or less fusible, or to produce certain results after baking. Alumina has a great affinity for water, of which clays absorb and retain a great deal, requiring a red heat to expel it entirely. When once thoroughly driven out in this way, the water will never again enter into combination with the clay. *Baked clay* is one of the most durable of substances.

Feldspar.—This is found pure in various places, sometimes in crystals, and sometimes in large masses. It is found rubbed into pebbles in the beds of streams, and often under cliffs, and is one of the constituents of many rocks. At the heat of the porcelain kiln feldspar melts into a milky glass. Potters almost always use the species called **Orthoclase**, or *potash-feldspar*, in which *potash* predominates. All the varieties are often called spar.

Albite.—*Cleavelandite, soda-feldspar.* In this the *soda* predominates. It is seldom used.

Fluorspar—this is *not* a feldspar at all. It is used in glazes, particularly in Germany. It is very fusible.

Petrosilex.—*Compact orthoclase—compact feldspar—rock-flint,—petuntze.*

Cornish Stone.—*China-stone—petuntze—pegmatite—caïlloux*—Different names used by potters for much the same rock. This is a rock resembling granite in appearance, and composed principally of *feldspar* and *quartz.* The composition of this rock varies considerably, so that it requires constant experiments to determine in what proportion the quartz and the more fusible parts stand to each other. The above rocky materials are used principally in the manufacture of porcelain, and also of fine earthenwares and stonewares.

The purest natural clay is **Kaolin**—*Kao-ling*, (Chinese, high ridge.) In Europe this is the name given to any colorless refractory clay that can be used for making porcelain. "Ordinary kaolin is the result of the decomposition of aluminous minerals, especially of the feldspars of granitic and gneissoid rocks and porphyries."—(*Dana.*) Kaolin is generally found associated with the rock from which it is derived by decomposition. Kaolin often contains gravel, sand and other minerals, which have to be carefully removed before it can be used for fine wares.

Kaolin is white, dull, and opaque. When kneaded with water it forms a ductile paste or dough; it is often mixed with potter's clay or with ball clay in making different wares. Kaolin is supposed to have been used for centuries in China, but its discovery and application in Europe only date from about the year 1700.

It seems uncertain now whether the Chinese use in making porcelain what we call kaolin, for what they obtained from the place Kao-ling was a greenish rock as hard as feldspar, which was then made into powder.*

Kaolins good for the potter's purposes are found in comparatively few places. Cornwall in England (whence Cornish clay), Aue in Saxony, St. Yrieix la Perche in France, are some of the principal European beds, while in the United States it has been found in Delaware, Illinois, Missouri, Vermont, New Jersey, Pennsylvania, etc., for analyses and details of which see reports of different state geologists.

In Lawrence Co., Indiana, is found a kaolin for which wonderful qualities are claimed. The analysis of it is very like that of what is called halloysite.†

**Am. Jour. Science*, March, 1871, p. 179.

†Since writing the above, Mr. Shakespeare M. Laughlin has informed me that the Lawrence Co. kaolin or halloysite was thoroughly tested in the pottery at East Liverpool. It did not at all equal the ex-

Ball Clay—often called *pipe-clay.*—This is essentially the same as kaolin, but has, as a rule, a greater proportion of *silica* in it, and is less pure. It generally has lime in it, and is usually of a yellowish or greyish hue, from the presence of iron. It is used in the making of fine pottery.

Potter's Clay—Is a still more impure variety, often rendered fusible by the foreign substances it contains. Common potter's clay, or loam, such as is used in brick pits, is one of the most abundant substances in nature, but is so impure that it can only be used for the commonest pottery. Other clay-like materials used by potters are *marls* or *calcareous clays*, composed of clay, carbonate of lime and sand in varying proportions, and *ferruginous clays* or *ochres.*

The principal other constituents of paste and glazes are:

Silica—as *quartz, sand, flints.*

Lime—as *gypsum* (sulphate), *chalk* (carbonate) *phosphate.*

Magnesite, or *meerschaum.*—In this *magnesia* takes the place of the *alumina.*

Steatite—*Soapstone, talc, potstone*—is also used a little in porcelains.

Hoa-chi, a kind of *soapstone*, and other materials as

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pectations to which it gave rise, on account of the impurities in it, and also because there was so much water in it that the shrinkage was unusually great. Mr. Laughlin has given me the analysis of a very remarkable kaolin derived from the decomposition of chert or hornstone. —See table, No. 21, page 38.

yet not very well known, are used in China and Japan.

Asbestos and the sulphate or carbonate of *Barytes* are occasionally used. In glazes and also a little in pastes are used *slag* or *blast furnace cinders* (common glazes).

Nitre or *saltpetre*—(nitrate of potash).

Salt.—*Sea-salt, chloride* of *sodium.*

Albany Dip.—A common clay found near Albany, N. Y. It is used in this country as a black glaze for stoneware.

Boric, or *boracic acid.*—This is principally derived from **Borax**—*borate of soda*—a compound of boric acid and soda. Up to the end of the seventeenth century nothing certain was known either of the source or of the composition of borax, which was used as a flux, and which was brought to the European market by the Venetians in the impure native state called tincal. The method of refining tincal was long kept secret, but in 1747 Baron pointed out that borax consisted of a compound of boric acid (then called sedative salt) and soda. It is now found in a great many places, and has of late years been extensively used. Borax, or boric acid, adds greatly to the brilliancy and hardness of glazes, and also improves the color of the paste.

The alkalies, potash and soda, are very seldom used alone. They are used in combination as above.

The oxides of *lead*, of *tin* and of *iron.*

The ochres—little used.

The oxides of *manganese.* These are said to impart great toughness to common earthenwares when used in the glaze.

Hot-cast Porcelain.—Cryolite—fluorid of *soda.* This was used in Pennsylvania for the manufacture of white glass, which was a very good imitation of porcelain, and which was called hot-cast porcelain, but was very brittle. It was very like soft porcelain—and the cryolite was used *instead of the phosphate* generally used in making milk glass.

It is by understanding the chemical nature and the real constituents of clays and other matters that such great advances have of late years been made in the manufacture of pottery; and, judging from many chemical analyses, it seems as if there may be many more materials that can be used in making fine pottery. Nevertheless, all clays and minerals must be carefully tested in potteries before their value to the potter can be definitely ascertained. Clays and spars from different localities that seem alike as far as chemical analysis is concerned, will act very differently in the kiln. Potters generally judge clay by its appearance, by adhesion to the tongue, by smell, and by touch, and by its plasticity. They also fire it and judge it by its shades of color.

Principal **Metals** used in decorating pottery, some of which are also used fcr glazes:

1. Arsenic—white.
2. Antimony—yellow, white.
3. Barium—yellow, white.

4. Copper—as metal, bluish-green and a red.
5. Cobalt—blue.
6. Chromium—green, yellow, blue.
7. Gold—as metal, pink, purplish-grey; also with tin in purple of Cassius—purple or crimson.
8. Iridium—black, grey.
9. Iron—red, yellow, brown.
10. Lead—yellows.
11. Manganese—brown, violet.
12. Nickel—used in preparation of colors.
13. Platinum—as metal, grey, black.
14. Palladium—grey.
15. Silver—as metal, used in carmines, purples, yellows.
16. Tin—white, a sort of pink, also with gold in purple of Cassius.
17. Titanium—yellow.
18. Uranium—black, yellow.
19. Zinc—improves or modifies many colors.

These metals are used as oxides, silicates, aluminates, chromates, chlorides, etc., and are combined in various ways, so producing a great variety of colors, tints and hues. New pigments or combinations are discovered from time to time, but are generally kept secret as long as possible by the keramist who discovers them.

Umbers, Sienna earths and ochres are earths naturally colored by iron and manganese. They are not now much used, the same colors being obtained by mixtures.

Calcium might perhaps be added to the above list of metals and metalloids, for its protoxide, lime, as phosphate, is now often used for white instead of the oxide of tin. When so used it must be chemically pure.

The phosphate or meta-phosphate of lime seems destined in future to play a more important part in the manufacture of pottery than it has done heretofore. It is usually made artificially from bones, but phosphorite and other natural phosphates of lime might be used in the preparation of the glaze, or even of the paste of much fine pottery besides English porcelain. Salvétat gives the following analysis of a natural phosphate from the north of France:

Clay and silica 25.66, lime 44.54, phosphoric acid 12.12, carbonic acid 7.33, water and volatile matters 10.33, and a trace of oxide of iron. It must be noted that the phosphate very much increases the fusibility of feldspar.

In one sense the assertion might be made that almost all the potter's materials are metals or metalloids; alumina, for example being oxygen and aluminium, or in other words is the oxide of aluminium. Potassium and sodium furnish the important alkalies, potash (hydrated protoxide of potassium) and soda (hydrated protoxide of sodium), while silicon and oxygen make silica (silicic acid), the absolutely essential element in all pottery.

ANALYSIS OF SOME

	Silica.	Alumina.	Magnesia.	Potash.	Soda.	Iron.
1. Feldspar (orthoclase)	64.06	18.05	....	16.09	(Soda sometimes replaces part of the potash.)	
2. Feldspar (albite)	68.06	19.06	...	...	11 08	....
	(A small part of the Soda is usually, if not always, replaced by potash and also by lime.)					
3. Quartz.....................	May be considered pure silica; it is very hard, is infusible and insoluble.					
4. Flint..................	Principally silica, with a very little alumina and oxide of iron.					
5. Fluorspar (Fluorid of Calcium)	....	Fluorine. 48.07	....	....	....	....
6. Yeou-Ko (washed) greenish rock..	75.09	14.02	traces	2.08	3.05	Oxide. 00.08
6. Yeou-Ko (raw).............	75.09	13.09	traces	2.09	3.08	00.07
7. Chesterlite (orthoclase)	64.97	17.65	0.27	14.02	1.69	0.50
8. Steatite (soapstone)	62.0	....	33.01	....	....	....
9. Magnesite (Carbonate of Magnesia, Baudisserite)..	....	....	39.00	Meerscha'm 19.20	....	....
	....	....	48.00	(Nearly always has meerschaum in it.—Brogniart.)		
10. Meerschaum, Sepiolite, hydrated silicate of Magnesia (sometimes called Magnesite)	60.8	....	27.1	....	....	....
11. Spain (Vallecas) Meerschaum	53.8	1.2	23.8	....	....	....
12. Cryolite, Kryolite..........	...	Aluminum. 13.0	....	....	Sodium 32.8	....
13. Tsuji-chu-chi (porcelain stone)	80.672	16.174	.102	.569	1.799	Ferreous ox. .684
14. Shiro-chu-chi } washed Japan	80.920	15.822	.100	.530	1.530	.932
15. Sakaime-chu-chi } washed Japan	81.141	14.542	.242	.999	1.789	1.060
16. Terre à porcelaine du Japon	75.09	20.00	...	3.05	....	....

OF THE POTTER'S MATERIALS.

LIME.	WATER.	CARBONIC ACID OR CARBON.	ANALYST.	REMARKS
....	....	....	Dana.	1, 2, 3, 4, 5, 8, 9, 10, 11, 12.—These are nearly all general formulæ. Feldspars, as well as the other minerals here mentioned, generally contain a little ox. iron, lime, magnesia, etc., and more or less alkali.
...	....	....	Dana.	
....	....	....	Dana.	
....	....	....	Dana.	
51.03	....	....	Dana.	
	Com-bined.	Mang. oxide.		
00.05	2.03	0.03	E. & S.	No. 6 is mentioned by Ebelman and Salvetat in their memoir * as a glaze ingredient. They say it is a greenish petro-silex. Compare with Baron Richtoffen's statement as to green stone. (Chap. 14, p. 149.) See also Wurtz's memoir, Reports and Awards, Group 2, Cent. Ex., 1876.
00.04	2.07	traces		
0.61	....	....	....	No. 7.—This is feldspar from Chester Co., Pa.
....	4.09	....		
		Car. acid.		
....	....	41.80	Berthier.	No. 9† is from Baudissero, Italy, and was used in the porcelain made at Vineuf, near Turin. Magnesia porcelain, though not so white as the Kaolin porcelains, has great toughness and lightness.
....	2.	49.00	Brogniart.	
....	12.1	. ..	Dana.	
....	20.00	....	Berthier.	No. 11. † A silicate of magnesia, much the same mineral as No. 8, is from Vallecas, near Madrid. This was used in Spain for porcelain. The magnesia paste is prepared with a little clay or kaolin in order to give it plasticity. All this is perhaps more curious than useful.
Fluorine.				
54.2	....	....		
		M. ox.		
.00	....	trace	Wurtz.	No. 13.—See very interesting article in Reports and Awards, Group. 2, Cent. Ex., 1876, for analyses of other Japanese porcelain stones.
	Sulph'r			
.152	trace	0.014	Wurtz.	
.195	...	.031	Wurtz.	
.06	....	....	Malaguti.	No. 16.—This often has a little iron in it. There are silicious varieties.

* Annales de Chymie et de Physique (3), vols. 31 and 35.

† See note 1, Appendix B.

ANALYSIS OF SOME

	Silica.	Alumina.	Magnesia.	Potash.	Alkalies.	Iron.
Kaolins.						
17. St. Yrieix	48.0	37.0	....	....	2.05	....
18. China	50.05	33.07	....	....	1.9	....
19. Lawrence Co., Indiana.....	45.90	40.34	....	....	....	....
20. Golconda, Ill...............	42.28	43.05	....	....	....	....
21. Beauregard, MarbleHill, Mo.	83.36	11.06	1.12	....	....	0.41
22. Near South Amboy, N. J...	43.20	49.71	....	....	....	0.74
Clays.						
23. Montereau (France)........	64.40	24.60	These clays contain a very little potash and soda.			traces
24. Stourbridge (England)	45.25	28.77				7.72
25. Devon (England)	49.60	37.40				....
						Protoxide.
26. Woodbridge, N. J.	43.690	38.300	.310	....	.447	.900
27. Mt. Savage, Maryland	44.395	38.558	.108	....	.247	1.080
28. Ballclay, Mo...............	65.69	24.87	1.12	....	0.37	2.54

OF THE POTTER'S MATERIALS.—*Continued.*

Lime.	Water.	Miscellaneous.	Analyst.	Remarks.
....	13.01	....	Salvetat.	Kaolins are generally very refractory. Should they contain 2 or 3 per cent. of alkalis they become slightly fusible.
....	11.02	....	Salvetat.	
trace	13.26	....	....	Nos. 19 and 20.—These are rather halloysites than true kaolins, and are objectionable in several respects, principally on account of the shrinkage.
trace	14.66	....		
trace	4.07	....	Chauvinet and Blair.	No. 21.—Snow-white clay, from decomposition of chert, which is a term often applied to hornstone and to any impure flinty rock. This is a remarkably fine kaolin for potter's use.
....	14.25	Zirconium. 1.40		
....	10.00	....	Salvetat.	No. 23.—Very good—used in fine earthenware.
0.47	17.34	....	Salvetat.	No. 24.—Refractory—used for crucibles, firebricks, etc.
....	11.20	....	Salvetat.	No. 25.—Fine earthenware, c. c. ware, etc. Compare with Montereau.
.480	15.120	Titanic acid. 1.000	....	Nos. 26, 27, 28.—American clays from State geological surveys. Many clays contain titanic and phosphoric acid in small quantities.
trace	14.575	1.530		
....	....	....		

PART II.

PROCESSES OF MANUFACTURE.

CHAPTER IV.

MANUFACTURE.

PASTES.

THE simplest method of using clay would be to wet it with water and fashion it into vessels which when dried in the sun would answer for holding anything dry, such as grain. This is done in some parts of the world, but such vessels are useless for liquids, as they melt in water. Sun-dried bricks are used extensively in Mexico, Egypt, parts of China, and other tropical countries, where there is not much rain, and answer well enough. Mounds of them still exist in Assyria, dating from very remote times. The next step, and a very great one, is to bake the clay; thus changing its composition, and rendering vessels made of it insoluble in water, and not easily affected by acids.

Paste.* *Body—clay mass* (Fr. *pâte*)—names given to clay either by itself or when mixed and prepared with other ingredients, paste, though dough would be more suitable, being the word generally used in books. For the very coarsest pottery, the clay is used as found, but for most wares the natural clay serves

* See note 2 Appendix B

as a base for the paste, and various matters are added producing combinations which are altered or modified in baking. Upon the kind of clay used, upon the ingredients with which it is mixed, and upon the degree of heat to which it is subjected in baking, depend the product; and in short, paste may be regarded as *modified silica.* A paste of silica and alumina alone will stand any heat. When there is a very little iron, lime, etc., in it, it will still stand a high degree of heat without melting. Much iron, lime, and other impurities *flux* the paste at a very low heat, so that it melts into a shapeless mass. The alkalies which are generally in the paste, as feldspar powder or dust, have no influence at all at a low heat, but as soon as the heat is sufficient to melt the feldspar, they often, with lime, act as very powerful fluxes. Roscoe classes pottery as an amorphous silicate.

The following table gives in a rough or general way the ingredients in different kinds of ware. Any student interested in this part of the subject will find fuller tables of pastes, etc., page 46.

TABLE OF PASTES.

Silica	alumina					Typical Clay.
Silica	alumina	lime				
Silica	alumina		ox-iron			Earthenwares and stonewares.
Silica	alumina	lime	ox-iron		alkali	
Silica	alumina		ox-iron	Baryta	potash	Stoneware.
Silica	alumina	lime			potash	Hard porcelain.
Silica	alumina	lime			soda	Soft porcelain.
Silica	alumina	magnesia				Piedmontese and Spanish porcelain.

These and other combinations, singly or together, are infinitely varied in different potteries, and depend, as a rule, more on experience and tradition than on chemical analysis or scientific rules.

Plasticity is one of the important qualities of clay or paste. A **Plastic** substance is one that can be fashioned into any shape and will keep it. The plasticity of clay is in the first place owing to the presence of water, for which alumina has a great affinity, and also depends on the fineness of the particles of clay. Too much or too little water takes away the plasticity, the clay being liquid in the one case, and a dry powder in the other, though the dryest clay still contains water. Some pastes, such as that of some soft porcelains, have no natural plasticity, and have to be mixed with gum, soap water, or something of the kind. Some clays, too, are naturally more plastic than others.

Potters call the more plastic clays or pastes *fat* or *long*, the less plastic, *short*. If the clay is too plastic, the shrinkage is such that the ware is distorted, and even cracks in drying, and still more in baking. This can be prevented by introducing various non-plastic and unshrinkable substances. Quartz, sand, calcined flints, calcined bones, chalk, baked clay or paste well pulverized (Fr., *ciment*), called **"Pitchers"** by potters, are all used. Sawdust is also used, especially in making water-coolers. It burns out, leaving spaces between the particles of clay. The more plastic a paste, the more it shrinks.

In some fine wares great allowance must be made for inevitable shrinkage, and the arrangement must be such as will assure contraction towards a common centre. This is easy in the case of a simple article like a plate, but requires careful calculation in more complicated forms.

Preparation.—For very fine wares the following operations are used to a greater or less extent. The clay is dug up in large masses, which, if necessary, are dried, and then broken up and all fragments of stone or coloring matter are carefully removed. The clay is then put into a cylindrical or octagonal box (blunger) within which is a shaft armed with strong paddles. Water, which should be very pure, is added until the mixture is as thin as cream. This mixing was formerly done by hand with a kind of rake. After working it until clay and water are thoroughly incorporated, (in the East this is often done by men or cattle treading the mixture in a tank), the liquid or **Slip** is drawn off through a series of strainers which retain all stones or coarse sand. The straining is continued through sifters or sieves of closer and closer mesh, until the fineness required is obtained, in many cases the final straining being through the finest silk gauze. In other cases the same result is obtained by the clay being washed down through a succession of pits or tanks, the heavier parts sinking to the bottom, and only the finer particles of clay being carried on by the water.

Any matters that are to be added to the clay, such as calcined flints, spar, sand, or calcined bones, must be ground exceedingly fine. This is done by methods varying from the excellent machinery used in England and America to the rough water mills of the Chinese and Japanese. An *impalpable powder* is the result in both cases, but in the former there is a great saving of labor and material. All these matters are generally ground in water, as the dust from them is very injurious to the workmen. This objection is obviated in Alsing's dry-grinding cylinder mill, used in this country, and which grinds the materials to the finest powder. The potter generally tells if the powder be fine enough by crunching it between his teeth, or by feeling it with his fingers.

After all the clays and rocky matters are prepared, they are sometimes mixed together in a powdered state; the usual method, however, being to have each ingredient mixed with a certain proportion of water, so that a quart of one will be equal to a quart of the other, notwithstanding their varying densities. Then they are generally all mixed together in a machine similar to that already described, water being added until the mixture is like cream, and will go through the finest sieve or gauze. It will not do to leave the liquid paste or slip in this state, as the heavier parts would soon sink to the bottom; and besides, in this state it has no plasticity. The slip must be dried until it makes a paste of the proper consistency.

Drying the Slip.—This was and is still done in many places either by exposing it to the air, by drying it in absorbent plaster boxes, by running it through a kind of trough or **Slip-Kiln,** of which the bottom and sides are made of bricks, which are heated, or by pressing it in bags. But in large potteries in Europe and America these methods are almost entirely superseded by an ingenious method of **Straining-Bags** invented by an English firm, and which can be found fully described and illustrated in any good encyclopedia. Much the same method, only imperfectly managed, was formerly used at Sèvres, and is still in use in China.

The paste now undergoes various operations, the object of which is to render it as homogeneous as possible in texture and to drive out all air-bubbles. In some few places in Europe, and all over the East, it is kneaded with hands or feet, generally the latter; a very old process, now hardly ever used for fine pastes, to which we find many references in sacred and profane history.

Treading.—The paste is placed in a circle on a level floor, generally tiled, and the workman walks with bare feet from the circumference to the centre in a spiral, until he judges the clay to be sufficiently tempered. The same effect is produced by putting the clay or the prepared paste into a mill, called a **Wedging-Mill,** a cylinder with knife-blades fixed in the sides and in an axis in the middle, so arranged as to cut up the paste and force it down in a spiral. By repeating this operation several times it is claimed that the same or a better effect is produced than by treading. All this is not enough for very fine wares, porcelain for example. Just before using, the paste for this often undergoes the process of "slapping." A man of considerable strength takes a lump weighing some fifty or sixty pounds, and cuts it through with a brass wire. The piece cut off is dashed with the man's utmost strength on the rest of the mass, and this is repeated until the mass is perfectly smooth and close in appearance wherever it is cut. He then often pounds it with a mallet. If all this is done well, the incorporation of one part of the mass with the other is so thorough that coloring matter placed in one part will be equally diffused throughout the whole mass. It also drives out the air, which is of the utmost importance, as a bubble would expand in the baking and ruin the ware. Wedging now generally takes the place of the picturesque operation of slapping, but still in the finest wares nothing seems entirely to take the place of hand work. The paste of hard porcelain is, after this, often made up into conical forms which are dried and then made into thin shavings on a lathe, and then put again through the same processes. It is claimed that this makes an excellent paste, less liable to crack or warp. A portion of old paste is also almost invariably mixed with the new.

Ripening (Fr., *pourrir*, lit. rot).—The paste, and in some cases, the clay, is often put into pits or cellars to temper, or else it is allowed to lie for years in pits exposed to the weather to ripen. The paste is kept moist, and in some cases is mixed with very impure water, so as to ferment and putrefy; some potters being of opinion that this tends materially to increase the homogeneousness of the mass. In China the paste is always kept for many years, a rather absurd etymology of porcelain being that it is derived from "pour cent années," as the paste was kept for that length of time, and was often prepared by men for their remote descendants.

Many wares do not go through all these processes, bricks and coarse earthenware and stoneware only having the stones and other impurities picked out, and being either kneaded or trodden, or else put through the wedging-mill, and then used. The finer the ware the more elaborate the preparation of the paste.

TABLE OF PASTES.

Kinds of Pottery.	Silica.	Alumina.	Magnesia.	Potash and	Soda. (Not Separated.)	Iron.
Soft Body or Paste.						
1. Peruvian	67.04	10.83	0.28	....	....	10.17
2. Madagascan	44.00	31.20	....			7.05
3. Campanian (Italo-Greek)	52.95	27.15	1.76	Either not present, or if present they will have no effect at all, the pottery being baked at too low a heat to affect them.		12.87
4. Etruscan	63.00	14.44	....	....	....	7.75
5. Roman (red) Luxembourg	54.39	24.24	1.83	....	....	10.24
6. Roman (gray)	61.58	25.78	3.05	...	...	4.27
7. Black, Gallic	62.22	18.36	0.47	...	....	5.71
8. Spain, modern	53.04	19.11	....	....	....	6.01
9. Portugal, modern	54.02	20.00	1.45	....	....	9.76
10. Coarse Earthenware	39.50	12.00	0.20	...	....	5.35
11. " "	36.50	10.50	....	....	....	5.40
12. Lucca della Robbia (majolica)	49.65	15.50	0.17	....	....	3.70
13. Delft Ware	49.07	16.19	0.82	....	....	2.82
14. Persian	48.54	12.05	0.30	....	....	3.14
15. Rouen	47.96	15.02	0.44	....	....	4.07
Hard Body.						
16. Palissy	67.50	28.51	....	traces	....	2.05
17. Henri II (F. d' Oiron)	59 10	40.24	....	...	....	....
18. Lunéville (terre de pipe)	67.39	16.00	1.02	traces	....	2.01
Very Hard Body. (Fine Earthenware.)						
19. Creil (France)	66.10	32.20	....	1.10	....	0.55
20. Minton (England)	72.60	24.10	....	2.20	....	1.10
21. Wedgewood (England).	76.10	20.45	0.14	1.60	....	1.00
Very Hard Body (Stonewares).						
22. Vauxhall (whitish)	74.00	22.04	0.17	1.06	....	2.00
23. Wedgewood (yellowish, unglazed)	66.49	26.00	0.16	0.20	....	6.12
24. Chinese, (reddish-brown, unglazed)	62.00	22.00	traces	1.00	....	14.00
25. Japanese (reddish-brown, unglazed).	62.04	20.30	traces	traces	....	15.58

TABLE OF PASTES.

Lime.	Water.	Carbonic Acid or Carbon.	Glazes.	Analyses Principally from Salvètat and Brogniart.
3.24	7.07	1.00	....	
1.25	15.24	1.26	....	Scarcely baked at all; unusually low proportion of silica.
5.25	...	...	....	Soft, marl-body lime, probably as silicate. This is the general composition of the finest potteries of this class, very old. Sometimes with lustrous glaze, now proved to be composed of silica and alkali with oxide of iron or lime, transparent glazes, sometimes black, probably iridium.
			sometimes lustrous.	
3.00	8.45	1.55	....	Many analyses of this Etruscan pottery upon great similarity, probably all made by about same recipe.
9.25	....	1.68	....	
2.17	2.04	0.99	....	
1.17	10.56	.78	....	Not baked enough to drive out the carbon; very low heat.
14.01	2.06	5.77	...	Very low heat.
4.76	5.97	4.04	....	Very low heat.
20.00	7.30	17.50	....	These were analyzed before baking; only well dried, which accounts for the water; all lime-body.
25.00	6.00	20.00	Tin or lead.	
22.40	...	8.58	Tin glazed.	Lime-body; this takes tin glazes very well.
18.01	....	13.09		Lime-body.
19.25	....	16.72		Lime-body; often has a borax glaze from tincal.
20.24	....	12.27		Lime-body.
1.52	....	....	Lead glaze.	Pipe-clay or ball-clay paste. Most of his pottery had a tin glaze.
....	....	....		Ball-clay paste, with a little kaolin in it, and there is probably a little iron, etc.
13.16	....	....		Old-fashioned French ball-clay body earthenware; often with tin glaze to make it harder.
0.14	....	..	Boracic.	Modern French flint-body, fine earthenware, made on English recipes.
....	....	....		Modern English flint-body, fine earthenware.
0.75	....	...		Modern English flint-body, when glazed with a soft lead glaze, this is much like the old c. c. ware.
0.60	...	....	Salt glaze.	Iron-body.
1.04	....	....	....	
0.50	....	....	....	Iron paste; these soften in the heat of the hard porcelain kiln.
1.08	....	....	...	

TABLE OF PASTES.—*Continued.*

Kinds of Pottery.	Silica.	Alumina.	Magnesia.	Potash.	Soda.	Iron.
Very Hard Body. (Porcelains.)						
26. Nymphenburg (Bavaria) ...	72.80	18.40	.30	.65	1.84	2.50
27. Meissen (Dresden).........	58.50	35.10	traces	5.00	....	0.80
28. Limoges	70 20	24.00	0.10	alkalies. 4.30	....	0.70
29. Sèvres	58.03	33.94	....	2.97	....	....
30. China (first quality)........	69.00	26.60	0.02	3.30	2.90	1.20
31. Japan (Eggshell ware)	78.763	17.847	.029	.203	1.975	.638
32. Japan (thick body porcelain)	74.545	19.315	.176	.566	2.832	1.916
33. Piedmont (near Turin).....	69.80	10.40	17.60	....	....	....
34. Worcester	82.00	9.10	7.40	....	....	....
35. Sèvres (old paste, about 1760)	74.50	2.00	....	2.60	1.00	....
36. Sèvres (about 1856).........	76.00	2.00	....	alkalies. 5.25	....	0.75
37. Tournay..................	76.45	7.35	traces	0.39	6.00	....
38. Persia	90.00	1.50	0.80	....	....	1.50

TABLE OF PASTES.—*Continued.*

LIME.	MANGANOUS OXIDE.	ANALYST.	GLAZES.	ANALYSES PRINCIPALLY FROM SALVÉTAT AND BROGNAIRT.
3.30	....	Veil-guth.	Earth Alkali.	Lime porcelain, no feldspar is used, but a good deal of lime. Roscoe gives Passau kaolin, 100; Bodemais quartz, 40; marble (lime), 10.
0.30	....	....	Feld-spar.	Brogniart and Prossel give gypsum, not marble; the alkalis come from the undecomposed feldspar in the kaolin, or from the sand. The glaze is an aluminous lime-glass.
0.70	....	....	....	Here is also made a hard body with a lead glaze. This is for decorative purposes.
4.58	trace	Laurent	Pegma-tite.	
0.30	....	...	....	The Chinese glazes have a large proportion of lime, at least ¼, and are more fusible than the European glazes.
.213	...	Wurtz	....	Washed tsiji-chu-chi, 70 p. c. Washed shiro-chu-chi, 30 p. c. For analysis of these clays see table, chap. 3.
.106	....	Wurtz	....	Washed shiro-chu-chi, 50 p. c. Washed Sa-kaimé-chu-chi, 50 p. c. These porcelains are very silicious, and are more fusible than the European.
2.00	....	....	....	A similar porcelain is made in Spain. See table, chap. 3.
1.30	...	....	Bo-racic.	The old English porcelains had flint-glass glazes, the modern have borax or boric acid in the glaze. No available modern analyses.
15.78	...	....	Lead.	Fritted body, flint-glass glaze, very soft and very brilliant. Soft porcelain will also take a lime-glass glaze.
16.00	....	....	Lead.	Fritted body, the soft porcelain made at Limoges, on much the same recipe, has sometimes a borax glaze.
11.20	....	....	Bo-racic.	A very good ware, stronger than the Sèvres, and suited to household use; also good for decoration.
3.00	water. 0.60	....	....	This is the analysis of an opaque, fritted paste, which, when sufficiently baked, produces a real translucent porcelain, having generally a silica-alkali glaze.
				In porcelain pastes, as in all others, the proportions vary slightly at different times, but never vary to any great extent.

It must be noted that the above are analyses, not recipes. Suppose a potter wished to make the paste analyzed as No. 19. (See list.) This is a fine earthenware made at Montereau or Creil, France. The potter would not take so much pure silica, so much pure alumina, etc., but obtains the desired result by taking—

Montereau clay (almost entirely free from iron)	20
Alberstone clay	20
English Kaolin	30
Limoges Feldspar	18
Ground flints or Quartz	12
	100

The glaze for this is very complicated.—

Borax (*soda*) and boric acid	40
Feldspar (silica, alumina, *alkalies*)	25
Carbonate of lime	20
Minium	20
Lime	19
Ground or pulverized oxide of lead	19

This is all melted together, forming a glass, which is then mixed with the following, and finely pulverized in water:

Above-mentioned glass (which is fusible)	62
Feldspar (more alkali)	13
Ground quartz or flints	25
	100

Some recipes are even more complicated. In some cases the desired result is obtained by mixing different clays. It is interesting to observe in how many different ways pretty much the same result is ultimately reached.

CHAPTER V.

MANUFACTURE.

SHAPING.

HAVING undergone all this preparation, the paste or clay mass is now ready to be made into shape. The primitive way of doing this was by the hands alone, and to this day jars and other vessels are thus made in many countries. Very large jars are made in Spain, the largest being called *tinajas*. They are literally built up layer by layer, and the paste is then smoothed and shaped by the workman, who is compelled to mount on a little scaffold for this purpose. These jars take a long time to build, and at least seven months to dry, when they are solid enough to be rolled to the kilns and hoisted into place by about forty men. The largest tinajas are from three to four yards high, and wide in proportion, and in many places are used as cisterns, also for storing grain, and in smaller sizes, for washtubs or rather pots. The regularity of shape in pottery hand-made in savage tribes is often very remarkable. A good deal of very pretty Japanese ware is simply pinched into shape with the fingers, notably the celebrated Banko ware.

Most pottery, however, is made on the **Potter's Wheel**, which is of great antiquity, the figures on the Beni Hassan tombs in Egypt showing that it has been in use for at least 4000 years. Birch says: "The application of clay to the making of vessels probably caused the invention of the Potter's Wheel (Fr., *tour à potier*), before which only vessels fashioned by the hand, and of rude, unsymmetrical shape, could have been made. But the application of a circular lathe, laid horizontally and revolving on a central pivot, on which the clay was placed, and to which it adhered, was in its day a truly wonderful advance in the art. As the wheel spun round, all combinations of oval, spherical, and cylindrical forms could be produced, and the vases became not only symmetrical in their proportions, but true in their capacity.

"The invention of the wheel has been ascribed to all the great nations of antiquity. It is represented in full activity in the Egyptian sculptures; it is mentioned in the Scriptures, and was certainly in use at an early period in Assyria. The Greeks and Romans attributed it to a Scythian philosopher, and to the states of Athens, Corinth and Sicyon, the three great rivals in the keramic art. The very oldest vases of Greece, some of which are supposed to have been made in the heroic ages, bear marks of having been turned on the wheel. Indeed it is not possible to find any Greek vases, except those made by the wheel or moulds, which latter process was applied only at a late period to their production." —Birch's History of Ancient Pottery.

Potter's Wheel.—The most common form of the potter's wheel consists of a spindle finished at its lower end in the form of a pointed pivot resting on a hard substance on which it can easily revolve; the upper end furnished with a *head* or *small platform*, on which the lump or ball of clay is placed. Between the head and the pivot is fixed a horizontal disk or wheel of large diameter, which acts as a fly-wheel, and keeps the spindle in motion for a long time. The wheel is put in motion either by means of a treadle worked by the potter himself, or by another man, or else, as in most large potteries, steam power is used. The form of the wheel varies slightly according to the power used in driving it. Such wheels as that shown in the frontispiece, and which may be regarded as typical, may be found almost anywhere; this one is drawn directly from that of a working potter in Philadelphia.

The processes for shaping articles vary with their form, and with the state of the paste, and principally consist of **Throwing, Pressing,** and **Casting.**

Throwing is performed on such a wheel as just described, and is used for hollow vessels. The potter places a ball-shaped lump of paste on the little platform, and as it rapidly revolves, he, with his fingers and a wet sponge, and perhaps some simple tools, fashions it into the shape that he desires; first making the lump into a cone, then forcing it down into a heap again; then thrusting in his thumbs and hollowing it out, he runs it up into a sort of hollow cone; then by hands, sponge, and pròper tools, shapes and finishes it off. The paste seems to take the desired forms by magic, and the work of the thrower looks very easy to do, but in reality it is very difficult to do well. Good throwers have to be trained, generally from their boyhood, particularly for the making of delicate ware of any kind. When the piece is finished, the thrower cuts it from the top of the wheel by slipping beneath it a brass wire. Sometimes, while the outside of the article is still rough, and only the inside smooth and finished, the thrower sets it aside to dry, and makes others like it. Then preparing a mass of paste as a mould on which he places his vessel upside down, he finishes off the outside with a tool resembling those used in turning wood.

The thrower in old times made and finished in this way all sorts of vessels, in fine as well as in coarse ware; and when, as was often the case, he was a man of true artistic feeling, he could impress his individuality upon his work from beginning to end. Now-a-days in fine wares the above operations are divided; the thrower only finishes off the inside, and another man does the finishing or lathing, on a horizontal lathe, very like the ordinary turning-lathe (potter's lathe, Fr. *tour anglais*). Small incised ornaments are also made by lathes and tools such as are used by metal-workers. In some cases the paste, after being dried until very hard, or even after baking, is entirely finished on the lathe. Old Sèvres porcelain was made in this way, and the same finish is applied to the Chinese and Japanese pastes. The former nation certainly had the lathe in common use as early as the thirteenth century. It is very difficult to make pieces exactly alike on the wheel, and the result depends on the skill of the potter; therefore to insure uniformity, other and more mechanical methods are used.

Pressing.—In order to make flat pieces, such as plates and dishes, the workman, called a *presser*, takes a piece of paste, beats and slaps it to expel the air, and rolls it out, or beats it into a thin layer. In some cases the paste is flattened out by means of much such a rolling-pin as a cook uses in making pie-crust; only instead of putting the flattened paste *into* the plate, the workman places it on a mould of the *inside* of the plate turned upside down. In fine wares great precaution must be used in lifting the paste, it being generally rolled out in a piece of soft leather. The mould with the paste on it is then placed on the head of the wheel, which in this case is called a **Jigger,** and consists simply of a spindle resting on its point, and provided with a head on which the moulds are placed. If the jigger is not moved by machinery the workman either keeps it in motion with his left hand, or more generally has a boy to turn it. He presses the bottom of the plate with an instrument called a profile, or rib, which is sometimes permanently fixed in its place, and which gives the exact profile of the outside of the plate, while the pressure reduces the layer of paste to the necessary thickness. The pressing is repeated at least twice. The plates are allowed to dry a little while, and then have consistency enough to be taken off the mould and smoothed off inside, and if necessary finished off more sharply and delicately.

Casting.—Large pieces, and many small ones, are now generally made in moulds of plaster of Paris, giving the shape and sometimes the ornaments of the *outside* of one-half of the vessel. In making, say, a pitcher, the workman takes a piece of paste, spreads it out in a thin layer, then lays it *in* the hollow mould, and with a wet sponge forces it into all the depressions thereof, being careful to keep it uniform in thickness. This process is repeated for the other half. The two halves, and often a piece for the bottom, are now put together and fastened strongly, the place where they join being wetted with slip, and pressed and smoothed over. The plaster mould soon absorbs the surplus water, and the paste is consistent enough to enable the pitcher to be lifted out and set away to dry. No matter how carefully the two parts are joined, and the seam smoothed over inside and out, the line of junction will show after baking; therefore, in fine ware, the position of this line is of considerable importance. **Plaster moulds** are a comparatively recent invention, the manner in which this substance absorbs water rendering it peculiarly suitable. These moulds have almost entirely superseded those made of baked clay and metal; though bronze moulds are still used for some kinds of crucibles, and small metal moulds for ornaments. The Chinese use moulds of dried clay.

Handles, spouts, and sometimes raised ornaments, are moulded separately, and are fastened on by slip. If the handles are oramented they are pressed in moulds, and the workman has to be very careful not to bend or distort them. Plain round or flat handles are made by the paste being forced in long strips through holes of the required shape, and are then cut to the proper length and stuck on with slip.

Casting.—For very thin ware, plaster moulds are used, made in one, two, or many more pieces fitted very neatly together, and held firmly in place by an outer mould inclosing all. Paste in the form of very thin slip, is poured into this mould; the slip soon adheres to the absorbent plaster, and the deposit rapidly increases in thickness. When the potter judges that the deposit is sufficiently thick, he pours out the extra slip; and when the layer of paste has dried and contracted, the mould is carefully removed. Compressed air is often forced into the mould in order to compress the paste, and give it sufficient consistency. Without this precaution very thin vases made in this way are apt to fall to pieces. This method is especially well adapted to the making of ware that requires very delicate and neat execution, and is now used in making very thin cups; these are made in a mould, and the foot is afterwards put on. The handles, too, of the egg-shell ware are sometimes hollow, and are moulded in the same way by liquid slip. They must be stuck on with the greatest care. This same method is also used for very large and thick vessels, the thickness being obtained by repeated layers of slip.

Moulds of the same nature as the above are used for *figures*, *animals*, etc., and are then often entirely closed up, except openings for the admission of the slip, and for the escape of the air. Porcelain buttons are also made in moulds by machinery. **Openwork** or basket ware of any kind is generally moulded solid, and then the spaces are cut out with a knife in the hands of a very skillful workman, or rather workwoman. When vessels, such as jugs and tea-pots, bowls, etc., are made double, and the outer case reticulated or cut into openwork patterns, the inner shape of the vessel is first made, then the outer shell is put in place, and slip is used on all the points of contact. This operation is very delicate, as both pastes must be of the same dryness or consistency, otherwise they will not contract equally. The outer shell is then cut into the wished-for pattern, without allowing the point of the knife to touch the inner shell. This does not apply to the delicate lacework and imitations of lace seen on porcelain or biscuit figures. In most cases, the production of this, difficult as it looks, is very easy.

A piece of lace, of the desired shape and pattern, is dipped in slip, and fastened in place upon the ware previous to baking. The lace itself burns away in the baking, leaving the design on the ware; and owing to the shrinkage, even more delicate than the original lace. In some other cases the work-woman, for women almost invariably do this sort of work, makes the patterns by dropping or dragging paste of the right consistency in the same way that confectioners make patterns on icing for cakes. The making of moulds is an important item in the expenses of a pottery. In large ones, moulds are generally made by men employed for this purpose. Those for finely decorated ware must be made by good artists, and famous sculptors are often employed for this purpose.

Bricks—Tiles.—All such articles as drain-pipes, bricks, tiles and ornaments for buildings are also moulded or cast, generally by machinery. Buttons and other articles, such as door-knobs, are often made from powdered paste, very slightly moistened, and then pressed by steel dies in a hydraulic press. The process is very curious. Tiles are also made from clay reduced to a powder, which being submitted in metalic moulds, to a strong pressure becomes so compact that it can be handled. Encaustic tiles are made from plastic clay, in which the different portions of the designs are sunk below the surface so as to form recesses in which slips of different colors are poured; when these become as hard as the body of the tiles, the surface is made smooth and level with a steel scraper, which removes all the superfluous material, till the colors are shown standing neatly side by side with the greatest precision (Arnoux).

The making of **Architectural Ornaments, Figures,** and **Bas-reliefs** has always been and is now an important branch of the potter's art. Figures, large and small, are modelled by hand in clay, and baked, being either glazed or left plain. The value of these consists in the beauty of the workmanship, and of the design, which may raise them into the region of the highest art. In modelling figures destined to be baked, it is necessary to add pounded baked clay, sand, or some other short substance to the clay; this lessens the plasticity of the clay, but renders it more difficult to model. Such figures, when well done, have a great charm, coming as they do directly from the artist's hands, without going through any intermediate processes. In an elementary work like this, it is not possible more than to glance at the above mentioned wonders of keramic art, some of which indeed seem hardly to come under the head of pottery.

All of the processes described, and many more, vary in different countries, according to the different wares, and also according as machinery is more or less used. Each potter has his own methods. The perfection of all the mechanical part of the work is found in England and America, where there are all kinds of ingenious lathes and other machines for shaping, turning, ornamenting, and smoothing off the wares. At Sèvres and at the other great porcelain potteries, wonderfully ingenious contrivances, which at the same time are usually very simple, are employed for shaping the inside and outside of vessels and figures, and for applying ornaments of various kinds. The best way thoroughly to understand all of the above, is to visit a large pottery, such as those at Trenton, N. J., Greenpoint, N. Y., East Liverpool, Ohio, or others. Once seeing the various processes stamps them on the mind as no description can possibly do. If this is not practicable, any common pottery where flower-pots or crockery are made, will be found very picturesque and interesting to see.

To return to the ware: After it has left the potter's hands, the articles, if moist, are taken to the drying stove or closet. Here they are placed on shelves, generally of plaster, in a temperature of about 125° F., until they are hard enough to be easily handled; then they are either baked and finished without any glaze, or else first slightly baked, "soft or easy biscuit" (Fr., *faible degourdi*), and then glazed; or thoroughly baked, "biscuit or bisque-ware" (Fr., *biscuit*), and then glazed: or they are baked and glazed at the same time.

CHAPTER VI.

MANUFACTURE.

GLAZING.

Biscuit.—The baked but unglazed ware is called biscuit or bisque-ware, a singularly inappropriate term, meaning, as it does, twice baked. All earthenware biscuits are porous and absorbent, as is also the soft or easy biscuit of porcelain. Thoroughly baked porcelain biscuit and unglazed stoneware are impervious to liquids; but, except in a few cases, are glazed.

Glazing—or *glassing*, is simply covering the ware with a thin coat of natural or artificial glass, so rendering it impervious to liquids. It is difficult to make a *good* glaze, as one that seems good at first may crack after months or even years have elapsed. Glazes must vary so that their fusibility may be more or less, according to that of the ware on which they are placed. They must also dilate and contract in the same proportion as the ware, or else they will crack, or as it is technically called "craze." As a rule, very siliceous wares are easier to glaze than those with a large proportion of alumina.

The substances most used for glazes are feldspar, kaolin, quartz, sand, lime in various forms, borax, and boric acid, sea-salt, potash and soda, fluorspar, ochres, the oxides of lead, of manganese, and of iron, and the oxide of tin. The oxides of all metals will combine with silica and alkali to form glass, but few will answer on account of their imparting color to the glass made from them. Minium and litharge, both oxides of lead, are powerful fluxes at a comparatively low temperature, and make a colorless glass, which on account of its cheapness, is much used in glazing. When there is an excess of lead, the glass is yellowish, and the lead is also easily dissolved out of it. Flint glass or crystal is composed of silica (siliceous or flint sand), minium (red lead), and carbonate of potash, and when well made is hard and brilliant, and has only a small proportion of lead in it. This, with often the addition of borax, is essentially the composition of the glaze for the finer earthenwares and some porcelains. The coarse earthenwares are often glazed with a glass containing an excess of lead, which melts easily, and is therefore used on wares baking at a low temperature. It is very unwholesome, and is easily scratched. Glass can be made without lead; crown glass is made of silica, the carbonates of potash and soda and quick-lime. The pegmatite or Cornish stone, and the feldspar used as the glaze of hard porcelain, may be considered a natural glass, formed by silica, alumina, potash, and soda. It requires a great heat to melt into a glass, which is never perfectly clear. Lime augments the fusibility of feldspar, and is sometimes added to it on that account. Fluorspar, which is nearly all lime, and is very fusible, is also used. *Borax* and *boric acid* are comparatively modern additions to the list of glaze materials, and greatly increase the lustre and the hardness of the glaze, besides improving the colors placed on it, and also improving the color of the paste. Sea-salt is used in glazing stoneware. The proportions of the different ingredients vary with every manufacturer, and many make a great secret of their particular glaze. (See Chap. IX., page 107.)

For all ordinary glazes the materials are ground to a fine powder, the finer the powder the more lustrous the glaze, and are mixed with water to a cream-like consistency, a little vinegar being generally added to prevent the precipitation of the heavier matters. This mixture is used without any further preparation.

Fritting.—If, however, any salt, soluble in water, such as borax, nitre or soda, be used, then all or part of the ingredients are first melted together into glass, which is run into cold water, breaking it up into fragments. This is called a *fritt.* The fritt is then pulverized, and, if necessary, the insoluble materials are added. The ware, when absorbent or porous, is simply dipped into this glaze-liquid. The water is rapidly absorbed, and a thin coat of powder is left on the surface, looking as if the ware was covered with powdered sugar. Any places remaining bare are coated with a brush, and the glaze is wiped off the pieces where they came in contact with the seggars. When the paste is not porous other methods must be used. The glaze-liquid is sometimes made very thick, and a little is dipped up inside the vessel. The vessel is then moved in different directions till it is covered. The outside is sometimes coated in the same way, or else, the vessel being of a suitable shape, is dipped into the glaze-liquid so that it just reaches the rim without flowing into the inside. This is often done when the inside is to be glazed a different color from the outside, and some dexterity is required to obtain an even coating.* The glaze is also put on with a brush, or by blowing through a tube, the end of which is covered with fine gauze, or the glaze materials in powder are dusted over the ware. This latter process is also used for very coarse earthenwares in which glaze and paste are only baked once. For classification of glazes see Chap. IX. The ware, being glazed, is taken to the kilns. In many cases after dipping in the glaze-liquid, and before the second baking, entire dryness is assured by subjecting the pieces for a while to a gentle heat.

* See note 3, Appendix B.

CHAPTER VII.

MANUFACTURE.

KILNS AND BAKING.

Kilns.—The main essential of a pottery kiln is that the heat be equally distributed all over. It is also essential that the smallest possible amount of fuel be used. In these, and in other respects, great improvements have been made of late years. The kilns often are somewhat the shape of the old-fashioned bee-hives, or else have cone-shaped stacks. They are often in two stories. Others, again, have straight sides and arched tops, while in England they are generally a low, vaulted chamber, with a cone-shaped stack. In very rough pottery baking there is no regular kiln at all, the pots themselves being piled up on a sort of floor and arranged to let the flames play over and through them.*

Pyrometers.—*Heat-measuring instruments.* One of the great difficulties in baking is in estimating correctly the degree of heat. So far, no instrument invented has been completely satisfactory, the pyrometers of Wedgwood and Brongniart being the ones most quoted. Both are good in some respects, but

* See note 4, Appendix B.

fail in others. For a full description of all pyrometers, see any good encyclopedia. Practically the potter generally judges of the heat by means of the color of the ware in the kiln, which varies from dull red to cherry red, orange red, white-heat, and dazzling or blue-white heat, seggars or ware being often lost to sight in one brilliantly white or even bluish-white mass. The following table gives some of the principal temperatures by means of the melting points of metals, which afford a standard of comparison:

COLOR OF WARE.	CENT.	FAHR.	MELTING POINT OF
Very dull red..............	525	977	
Dull red.........	700	1292	
Brighter red................	800	1472	
Cherry red........	900	1652	
Bright cherry red..........	1000	1832	Silver
Very deep orange red......	1050	1922	White cast-iron
Deep orange red...........	1100	2012	Grey cast-iron
Orange red.................	1200	2192	Gold
Whitish...........	1300	2372	Steel
Brilliant white heat........	1400	2552	
Dazzling white heat.........	1500	2732	Wrought-iron
Blue-white heat............	1600	2912	
The heat is sometimes even greater, being equal to...	1800	3272	

To Measure the Heat the potter also often places in different parts of the kiln small pieces of paste made in various forms, and glazed or unglazed, and which pieces are so arranged as to be easily taken out and examined. By such means the experienced potter can tell the degree of heat with great exactness. He can see into the kiln by means of small holes left for the purpose, and which are carefully stopped up when not in use so as not to allow any cold air to enter.

Fuel.—In old times wood, well dried, but not too dry, was always used, but charcoal, coal, coke, lignite, peat and gas have been and are used in different countries. Coal is now generally used in Europe and America, and wood in China and Japan.*

Seggars. (*Fr. cazettes.*)—Valuable wares, when ready to bake, are generally placed in seggars, boxes of hard pottery, fusible only at a higher temperature than the objects they contain, and oval, cylindrical or square in shape. The manufacture of seggars is an especial and important branch of pottery. Very large potteries, however, often make their own seggars. The seggar for some wares, porcelain, for example, must be able to stand intense heat, and must not have anything in its composition, such as sand, which would burst with the heat and fall on the ware, nor must it evolve injurious vapors. The inside of the seggar is sometimes partially glazed to avoid dust, but above all to avoid sucking or absorbing the glaze from the ware. Old seggars are the best, and even after they are broken, the pieces are fastened together for use. After the seggars are properly packed, they are piled up, the bottom of one forming the top of the other; a roll or *wad* of clay being placed where they meet, so that no vapor can penetrate. Each seggar is practically a small oven. The piles of seggars, called bungs, must be far enough apart to allow the free circulation of the heat, so that

* See note 5, Appendix B.

ali are equally heated; nevertheless, there are always some parts of the kiln hotter than others, and here are placed the pieces requiring the greatest heat. Some kilns are so arranged that two bakings can go on at the same time, one requiring less heat than the other, such kilns being generally in two stories. Plates and all flat pieces require less heat than hollow ware. The length of time required in baking depends entirely on the kind of ware, fine earthenwares taking about 60 to 75 hours for biscuit, and 20 to 35 glaze; English or bone porcelain about the same; artificial or fritted porcelain from 80 to 100 biscuit, 30 glaze; hard porcelain 20 to 50 hours for paste and glaze; stoneware from 48 hours to a week. Care must be taken to cool the ware very gradually, and to admit the cold air with great precaution, or the pottery will crack or break in pieces—*dunt* or *shiver*.

Bricks, tiles, and some kinds of common earthenware and stoneware, are often merely piled up in the kilns, and the fire plays directly on them. If necessary to prevent the upper pieces from crushing or distorting the lower by their weight, little supports of fire-clay are used, or else a kind of shelves. This same method of supporting is often used in the *first baking* or *soft biscuit* of porcelain and other fine wares; only then the pieces are very carefully propped up. The wares, and what they rest on, and the inside of the seggars, are generally sprinkled with flint sand, or with powdered baked clay, to prevent the pieces sticking, just as a cook uses flour.

Pottery when glazed must be packed or *placed* with the greatest care in seggars or kilns, which are then called **Gloss-ovens.** The pieces are supported and held apart by little fireclay instruments or props, which from their shape derive such names as *pins* or *thimbles*, *watches*, *cock-spurs*, *triangles* or *stilts*. Formerly, the workmen pinched these into shape with their fingers; now, they are much better made from steel dies by machinery, the edges and points in all cases being made as sharp as possible. Sometimes they project from the sides of the seggars, and the plates hang or are *slung* upon them; sometimes they are little tripods supporting the pieces on three sharp points. Care is taken to have the point of contact as small as possible; nevertheless, three small unglazed points can always be found on the under side or on the extreme border of plates and other articles supported in this way. In old-fashioned, and in Chinese wares, these points are often large and rough, but in the best factories of to-day they are ground off and the place often polished by machinery. Hard porcelain, even when glazed, generally stands on its base, or else upside down, and the glaze is wiped off the rims before putting it in the oven. Earthenware, fine and coarse, as well as some fine biscuits, is almost always slung from thimbles or pins from the sides of the seggars.

The above methods only apply to wares that do not soften or soften very little in the last baking. It is evident that only a stiff plate could have its whole weight supported on three slender points without bending. Wares that soften require the most minute precautions, and have supports or setters of the same shape, or are held in shape by other ingenious contrivances. When glazed, the difficulty, naturally, is still greater. The old Sèvres soft porcelain was a most difficult ware to bake; the paste was very expensive, and yet had to be used for the supports, which could only be used once. All ware requiring such precautions must necessarily be very costly.

The packing of kilns, gloss-ovens, or seggars, and the piling into bungs of the latter, is of the greatest importance in all cases, as, if there is any defect in the work, the whole batch may be spoiled. Skilful and experienced workmen are required, and the man who is a good placer, that is, who can pack seggars very full with safety, is a valuable man in a pottery.

CHAPTER VIII.

DECORATION IN GENERAL.

Decoration.—Some pottery is so beautiful and pure in form, and so delicate in texture that it seems superfluous to decorate it at all. Nevertheless, after being made into forms more or less good, pottery generally is decorated. The decoration may be effected by applying plain or colored ornaments in relief, or by stamping, inlaying, or incising, and may be either glazed or unglazed. These methods have been used by nearly all nations, and from the earliest times. Man is so fond of color that he uses it on almost everything, and to the operation of this general law pottery is no exception. Even among savage races, the effort is made to add to the value of the vessel by ornamenting it with colored substances. When actual colors are not used, light and dark tints or shades are employed, so as to give play and variety to the surface.

Pottery may be decorated by colors mixed with oil or varnish, but this is *not* true keramic decoration, and would be utterly destroyed by a very low degree of heat, and also by many oils, acids and other agents.

The colors or paints used in decorating pottery are especially prepared, and are practically indestructible. The fact that all such colors must be able to bear a high temperature, effectually excludes all animal and vegetable pigments, and only allows the use of metals or of colors derived from them. (For list see Chap. III., page 34.) These are generally spoken of simply as the **Oxides** of the various metals. The oxides are sometimes mixed with the paste of fine ware, such as porcelain or fine stoneware.* Much pottery is colored by the presence of oxides of iron in the clay. The coloring matter is also combined with earthy or with glassy materials. In all cases it is necessary that the colors used, whether incorporated with the paste, or laid on the surface, should, when baked, remain unchanged in hue, or else should change in a manner definite and predetermined. Also, that when applied on the surface, they should adhere firmly to the body of the ware, and that when applied on the glaze they should in most cases be as glossy as the glaze.

Engobe or *slip.*—When colors are mixed with earthy matters this name is given to them. Some slips, such as the ochres, are natural mixtures, and require little preparation. In others the color is mixed with a white clay. The same name is given to a coating of white clay laid over coarse or colored

* See notes 5, 7, 8, Appendix B.

pastes to conceal them, and to give a good surface for decoration, and sometimes in order to economize the tin-glaze, which is not a slip, but an enamel glaze (see majolica). Slips of various colors can be used on the same article, and a slip can be either glazed or left unglazed. Slips or engobes, generally without a glaze over them, have been used at all times, and on almost all potteries; at present, however, owing to the great improvements in the texture and whiteness of pastes, they are not needed to hide the color of the paste of fine potteries. Much of the Wedgwood ware has a colored slip laid over a white body. This is oftener seen in later specimens of the ware, as the earlier ones are almost invariably of one color throughout the paste. The term *slip* (diluted paste) can also be used to designate *all* applications of clays or pastes to the body of the ware, such, for example, as the méthode Laurin, and pâte-sur-pâte—**Méthode Laurin**—*peinture emaillée* (lit. glazed painting), **Limoges Style.** (For origin see Chap. X., mezza majolica.) In this the decoration is done by means of coloring matter* mixed with thin paste. This gives a good body to the paints, so that they can be used with bristle brushes, and the painting is done much as in oil painting. **Slip-painting** would seem to be a good English name for this method and its various modifications, the terms

* Which may be either with or without a flux.

enamelled oil-painting, or even glazed painting, giving a false impression to the student.

This method seems capable of great development, and new applications are made of it every day, the resources it offers to the decorator being very great. The slip can be made thick enough to be actually modelled with the brush, fingers, or tools. It can also be etched upon, scraped, stamped, and otherwise manipulated. Slip paints and body must correspond exactly in composition, particularly when, as at Limoges, the paints are used on the unbaked or green ware, and consequently the risk of cracking is very great. The number of colors available naturally corresponds to the degree of heat required in baking. A soft flint glass, or, as it is often called, an alkaline glaze, is usually put over the whole, said at Limoges to be the same as that used on old Sèvres.* This was: litharge, 38; sand, 27; calcined flints, 11; carbonate of potash, 15; carbonate of soda, 9; which bakes at about 1000° Cent., 1832° F., or a pretty fair red heat. This glaze softens at 600° to 700° Cent. Another glaze is sand, 34; minium (lead), 56; borax, 8; nitre, 2; and is harder than the preceding. The transparent glaze in all cases gives great beauty and richness to the colors. The composition of both slip colors and glazes differs in the different potteries, and there is generally great secrecy preserved in regard to it. Much the same style of decoration is used on baked or biscuit ware, but the results are not always so fine.

* See note 7, Appendix B.

In this country people generally speak of all slip-painting as Limoges style, or decoration, although the style as now used at Limoges really originated at Bourg-la-Reine (See Chap. X.). The best work of this kind is done in France by good artists, and the colors, no matter how much fused or run together by the baking or glazing, must be harmonious. Many people seem to imagine that the beauty of such work consists of the jumbling up of a mass of color without any sense in it. On the contrary, in the best work the painting is done with the greatest nicety, with especial reference to the after effect desired. Much poor work is sent over here and sold at large prices. Attempts that, it is to be hoped, will be successful, are being made to introduce this or analogous methods of decoration in several places in this country. (See Chap. XVI.)

Pâte-sur-Pâte (lit., *paste on paste*) is the name by which slip painting on porcelain is best known in this country. *Cru-sur-cru* and *pâtes d'application* are other French names for this, which has no distinctive English name. At Sèvres, about 1847, M. Riocreux was struck by the decoration on a Chinese porcelain vase. This was decorated with raised ornaments in translucent paste. He showed it to M. Ebelmen, the chemist, who discovered a method for its reproduction. M. Robert, director at Sèvres, has still further improved on this process, and most beautiful work is done, in both hard and soft porcelain. In most cases, in hard porcelain, the ground alone is colored and the figures or ornaments are in very translucent white, but sometimes both are colored. Only a very few colors are available, on account of the high degree of heat required in firing. The effects caused by the translucent paste are wonderfully beautiful. In soft porcelain the range of color is naturally much greater. This method has been transmitted to the English by M. Solon Milés. M. Solon had some work at our Centennial Exhibition, in which the decoration, consisting for the most part of floating figures modelled or rather painted in thin, white, highly-fluxed paste or slip on the colored body gave rise to very delicate aerial effects. All work of this nature, when it comes directly from the artist's hands, must always be very precious.

The other method of applying color to the surface of pottery is by mixing it with a transparent glass or flux; which may be either natural or artificial, and when baked melts and firmly fastens the color to the ware. The principal ingredients for fluxes used either singly or mixed, are very much the same as those for glazes, and are quartz, feldspar, borax, nitre, the carbonates of potash and of soda, minium, litharge and the oxide of bismuth, making a glass which should be more or less fusible according to the fusibility of the color, and of the surface to which it is to be applied. As the pigments used vary in their chemical nature and combinations, the adjustment of the proper flux to its color is a matter of great delicacy, and requires knowledge, skill and experience.

In many cases it is impossible to tell why a flux made with a particular sand or feldspar should be better than one made with materials apparently chemically identical, but so it is. For clearness and convenience we will call all colors so prepared fluxed paints.

Fluxed Paints may be subdivided into **Enamels** and **Vitrifiable Paints.** This distinction is not generally observed in speaking of them, the terms being used indiscriminately; and although the distinction may not be of much practical value, it is well to bear it in mind, as the differences between certain styles of decoration are then more easily understood. The term fluxed paint covers both classes, and will be so used here.

Enamels.—These differ from the *vitrifiable colors*, properly so-called, in that the coloring matter may be said to be *dissolved* in the glass (in this case a true flux). not *mixed* with it; and chemically speaking, enamels are silicates, borosilicates, or phosphosilicates, colored by oxides in solution. Only a small portion of coloring matter can be dissolved in this way, and in transparent enamels or glasses depth of color can only be obtained by the thickness of the enamel, which is generally, when used as a paint, perceptibly raised above the surface of the ware. Colored glazes and most of the colors called gloss-oven or underglaze (Fr., *couleurs de grand feu*), are enamels. Enamels may either first be prepared with the color and placed on the pottery, or else the ingredients for the enamel may be placed on it, and in melting combine together. The lower the temperature at which the pottery bakes, the greater the variety of colors that can be employed, and the more fusible the enamel, those used on coarse earthenwares being very fusible. The beautiful ground colors used in *Sèvres* and other *soft porcelains* are enamels, and in many cases are placed over a colored slip, giving effects of color unattainable by any other method. When the enamel used as a ground color is hard enough, other more fusible decorations in color or metal can be placed on it. In painting on the glaze, enamels can only be used under cetain conditions, else they will crack off. Enamels may be more or less *transparent*, or they may be rendered entirely *opaque* by the addition of very carefully prepared phosphate of lime, or by the oxides of tin or of antimony. (The enamel used on metal is the same as the above, and such enamel is now used in Europe in various methods of decorating pottery, and has always been used in China.) *

Vitrifiable Paints.—When the coloring matter is *mixed* with the flux, instead of being chemically dissolved in it, we have true vitrifiable paints of which most of the colors used in painting on the

* Annales de Chimie et de Physique (3) XXXI. 257, and XXXV. 312.

glaze of hard porcelain are a good example. In these the flux melts and envelops the coloring matter, and fastens or glues it firmly to the ware. Such paints must possess the following qualifications: 1. They must melt at a certain known temperature without changing; consequently, any volatile or organic pigment is absolutely excluded. 2. They must adhere firmly to the body on which they are applied; and in order to be sure of this it is necessary to know the chemical nature of the body, so as to judge of its influence on the color. 3. They must, as a rule, be glossy after they are fired; an exception to this is in the case of flat or unglazed colors. 4. They must not be liable to injury from water, from damp or dry air, or from gases in the atmosphere. 5. They must dilate or contract in the same proportion as the surfaces on which they are applied. As a rule also, the tone or shade of the color after firing, should as nearly as possible be the same as before firing; and in many cases the colors must be so composed that they can be mixed together without destroying each other. These rules also apply to enamels when used in painting. All fluxed paints are generally more fusible than the surface on which they are applied. Sometimes, as in the case of those used in painting on the glaze of hard porcelain, the difference is very great, and the paint, melting at a low temperature, while the glaze remains hard, will always have distinct and rather hard outlines, and if not well compounded may crack or even scale off.

With a more fusible glaze, such as that of soft porcelain, and some fine earthenwares (faïences), which softens enough to allow the paint to sink a little into it, the effect is much more rich, and paint and glaze are so thoroughly incorporated that there is no danger of scaling. In some cases, as in majolica, color and glaze melt and mingle together, giving great richness and softness of effect. The substances generally used for fluxes have already been named. In a work like this it would be impossible, and, indeed, useless to give recipes for the making of colors and fluxes, which vary slightly with each maker. As an example, however, it may be interesting to know that at Sèvres the flux for greys (*fondant aux gris*) used in overglaze porcelain painting, and which is also used for blacks, reds, blues, and yellows, is composed of six parts of minium (red-lead) to two of quartz sand, and one of borax. A German flux used in much the same way is 60 minium, 15 silica, 25 boracic acid (cryst). Both flux and coloring oxides, with the greatest care, are ground to an impalpable power; on the *fineness of which depends to a great extent*, the *brilliancy* of hue, and *glossiness* of surface. They are then mixed in proportions averaging three parts of flux to two of color, but these proportions vary according to the hue or shade desired, and also according to the ware on which the paint is to be used. In some cases—such as the copper greens and cobalt blues, when in order to develop the full tone of the color it has to be subjected to a greater heat than when used as a paint—color and flux are melted together first, then cooled and ground to a fine powder. It is as a fine powder that fluxed paints are usually put in the market. In order to use them, they may be mixed with water, gum-water, honey, or any like liquid ; more generally with turpentine, both in its liquid or thin state, and in the thick and sticky state, caused by exposure to the air, technically called *fat*, or fat oil. Oil of lavender can also be used *fat* and thin, and presents many advantages, but is expensive. Other essential oils are used either alone or added to the above, almost every decorator having recipes of his own.

The great attention given by eminent chemists in France, Germany, and elsewhere to the manufacture of fluxed paints of late years has enriched the palette of the European decorator by the addition of many new and beautiful colors.

Pottery paints of all kinds are divided into three classes, according to their power of resisting heat, as—

1. **Underglaze** — hard — high — refractory or **Gloss-Oven Colors** (Fr. *couleurs de grand feu*).

2. **Hard Kiln**—or *medium heat* (Fr. *couleurs de demi-grand feu*, or *de mouffle dures*).

3. **Regular Kiln**—*soft* or *ordinary muffle heat* (Fr *couleurs de mouffle ordinaires*).

Underglaze Colors.—This term, as the equivalent of the French name, is not perfectly satisfactory, as much decoration is done *in* the glaze, or by means of colored glazes, but is the expression generally employed. Gloss (glaze) oven seems a better expression, as the above names are given to all colors that bake at the same temperature, and at the same time as the glaze of the ware on which they are used, and consequently are baked in the potter's kiln. All colors that can bear the temperature necessary to bake the glazes on the different wares being classed as *gloss-oven*, or in many books as *underglaze colors* for those wares. As colors are often used on the biscuit, and the glaze put over them, *underglaze paints* would seem to make a good subordinate division of **Gloss-oven Colors**. Most gloss-oven colors are *enamels*, *not* vitrifiable paints.

This distinction is, as a rule, not observed in speaking of them. Gloss-oven colors require a special preparation for each kind of ware, so that they shall not be injured by any of the ingredients used in the paste or the glaze. The slip or engobe painting before described is naturally done with gloss-oven colors. The higher the temperature, the fewer the colors.

In the case of hard porcelain or stoneware with feldspar or salt glazes, the colors must undergo the most intense heat used in pottery baking; consequently the list of colors for these wares is small, and no explicit direction need be given for their use, as they can only be fired in the kiln used for baking the wares. Gloss-oven colors for hard porcelain are, in Europe, generally fluxed with feldspar, and are generally used on slightly baked or easy biscuit porcelain, which is porous and absorbent. When so used a thin layer of varnish or gum is first put on, and then the painting done on this, blue being the color most used; the varnish is then burned away by baking at a moderate heat, after which the porcelain is glazed and has its final baking. In China the paint is used on the unbaked or green body. (See Chap. XIV.)

Formerly in Europe porcelain gloss-oven colors were but little used except as grounding colors, in which case the color was simply mixed with the glaze.

Of late years much attention is given to painting in underglaze colors on porcelain, and magnificent results are obtained, most of the potteries keeping their methods secret. The feldspar glaze of hard porcelain is never perfectly clear, and this gives great softness to the colors. Soft porcelain has a larger range of colors, owing to the less degree of heat required, and for wares and glazes baking at still lower temperatures, the list is much larger.

In some cases (tin-glazed earthenwares and some fine earthenwares) the painting is done on the *unbaked glaze* (*Fr. sur cru*), which is much like dried flour and water; very absorbent and easily rubbed off. No corrections can be made, but in the hands of a good artist beautiful effects can be obtained, color and glaze melting together in the baking and becoming thoroughly incorporated. Sometimes the painting, particularly on tin-glazed earthenware, is done on the *baked* glaze, and color and glaze are then melted together. This is much easier to do than the first method, but the effect is not nearly so fine. Sometimes the ware is glazed, and then painted, and afterwards glazed again, so that the color is between two sheets of glazing. Gloss-oven colors are used on the biscuit of fine earthenwares, and are then spoken of as **Underglaze** colors. (For details see Chap. XVI.) Much decoration is also printed or stamped under the glaze. The methods used in printing on pottery do not essentially differ from those used in printing on paper, being effected by transfer papers from engraved copper plates. Sheets of gelatine, or of glue, are also used, this being the more common method. Various new methods are continually invented, a sort of photogravure being also used. **Printing Underglaze** is much used in *earthenwares*, porcelain being printed overglaze often only in outline, which is then filled up by hand. A species of chromo-lithography has successfully been transferred to porcelain in gloss-oven colors, but it is a question if this can be regarded as much of an acquisition. The finest work is always done by hand. Printing on pottery was invented by Dr. Wall, of Worcester.

After decorating, if turpentines or oils of any kind have been used, the ware undergoes a preliminary baking, before the glaze is put on. This is called *hardening on*, and requires at least red heat. The glaze is then put on over the painted or printed decoration (generally by a dip), and hides them entirely until it is baked, when it melts into a more or less clear glass. All the above methods of using the gloss-oven colors, except perhaps the painting on the biscuit of fine earthenware, require skill and especial training, and should not be attempted by amateurs. These colors of which we have been speaking may be considered as the **Potter's Hard Colors.** Decorators when speaking of high or hard fire colors mean those of the second class, generally known as **Hard-Kiln,** or medium heat colors, and sometimes as hard or high muffle colors. These and those of the third class, the regular or ordinary kiln colors, are applied *on* the baked glaze, never under it, and the two kinds differ very little in composition, the principal difference being that the hard-kiln colors have less flux than the regular kiln colors, and consequently can bear a much greater degree of heat. A background of these colors, therefore, can be treated almost as the glaze itself in regard to the regular colors, which can be used on it with impunity. A certain kind of gilding can also be used.

The late François Richard, of Sèvres, invented a method of using hard-kiln colors on hard porcelain which is called after him (*Méthode F. Richard*), and for which he received numerous medals. The mechanism of this method consists in making a sort of trinity of fusibility for all the principal colors, such as red, yellow, green, etc., each color being made up by the chemist into little packets marked D (*dur*) for the hardest, O for the ordinary fusibility, and T (*tendre*) for the softest colors of all. The painter is guided by this classification in the choice and use of the colors which, properly mixed or else combined by placing one over the other, give, after a baking special to this kind of work, effects equal to the finest soft paste porcelain decoration. In the use of the iron colors the artist has an advantage over the worker on soft paste, where they cannot be used. The firing of paintings done in this style requires great knowledge and experience. The glaze of the porcelain is not fused, although such is the effect produced. Some very beautiful pieces painted in this style excited great admiration at the exhibition that has just closed in Paris.

The colors of the third class, called **Regular,** or **Ordinary Kiln Colors,** and sometimes *soft muffle colors*, are those sold in tubes, or in powder for painting *on* the glaze of porcelain or of fine earthenware, and are variously called in the shops enamel colors, mineral paints, porcelain paints, etc. It may be noted that Lacroix, who makes the tube colors so much used here, calls them "*couleurs vitrifiables*," which in the catalogues and on his boxes is translated enamel colors. Both regular and hard-kiln colors are nearly all true vitrifiable paints, *not* enamels.

The degree of heat required for the regular colors being only cherry-red heat, or less, the number of them is very great. When used on tin-glazed earthenware they are called *couleurs de réverbère*, and differ slightly in preparation. All the great keramists, and indeed many good decorators, have methods of varying their colors and the effects derived from them, both over and underglaze. Most of these methods are kept secret, some have been discovered by accident, some by persistent endeavor. It is possible for the decorator to fire or fuse some of the softer glazes in his oven, or muffle, but such work would require knowledge, care, and experience. Much of the beauty of a painting on porcelain depends on the way in which it is baked; the more delicate the painting the more care is required.

The term **Muffle Colors** is sometimes given to the regular kiln paints, because they are baked in a small oven or kiln called a **Muffle**; fire-clay boxes, with fire underneath, or at the side, and with flues so arranged that the heat circulates around the box and heats it as evenly as possible. It is essential that neither the fire nor any vapors from it must be able to get access to the painted ware, as the colors would be damaged, particularly by sulphur, which blackens them. These fireclay boxes, or muffles, may either be all in one piece, as is the case with very small ones, or be built up to a large size. The top is generally arched, and the muffles are generally longer than they are high. There is a door in front, and a hole is left with a fireclay tube in it through which a long wire can be introduced with a bit of porcelain having the test color on it. There are also generally holes for the escape of noxious vapors from the paints, or rather from the oils, etc., with which the paints are mixed. The *placing* or filling the muffle requires great care, as the pieces must be so arranged as not to injure each other. Paintings, particularly if delicate, should never be baked in the muffle with much gilding, as this latter is apt to injure the colors. Old muffles are always the best; indeed, a new muffle should never be used until it has been brought to red heat two or three times, so as to drive out every particle of moisture, or else the colors will be injured very much. As long as a muffle will hold together and keep the smoke out it is used, the broken parts being held together by wire, and the holes or cracks stopped with clay.

The pieces to be baked, and the muffle itself, should be heated while this latter is being packed. The placing requires very great care. It is important to fill the muffle as full as possible, and it is difficult to do so without either letting the pieces rest too much one on the other, or else placing them so that the circulation of the heat is interfered with. All kinds of little props and supports are used. There is always danger of a little dust in the best mufffes, and plates and other flat pieces should be arranged with great care so as to avoid this. Very fine paintings should have a cover arranged over them. Sometimes pieces of fireclay or other materials are arranged to shelter the pieces to be baked from the heat from the sides of the muffle, where it is always most intense; but in regard to such arrangement no rules can be given. In this country very delicate precautions seldom if ever are used, as few of the firers have any idea of the use or necessity of any such precautions; and, indeed, to tell the truth, they are not necessary for most of the work done. After the muffle is properly filled, all cracks are stopped up with clay, and this should be very thoroughly done, particularly towards the bottom. The fire should be clear, with no smoke, and the heat should be so arranged as to heat the ware slowly at first, and then very rapidly at the end; *this is very important*, for if the heat is about the same all the time, the colors will not glaze well. Decorators judge of the degree of heat either by the color of the fire, or the color of the ware, but this can only be done by a man having a long experience in the matter. More generally "tests" are used: small pieces of ware, painted with a brush-mark of color, almost always carmine, and having a wire twisted round them by which they can be easily hooked out; they are placed in different parts of the muffle and are brought out and examined from time to time.* The annexed table of the principal temperatures may be useful.

* See note 9, Appendix B.

TABLE OF TEMPERATURE FOR MUFFLE COLORS.

	CENT.	FAHR.	COLOR OF THE CARMINE TESTS.	COLOR OF WARE (APPROXIMATE).
1. Shell or liquid gold over background of regular kiln color...	500	932	Reddish, dirty bricky brown, hardly glazed at all..................	About very dull red.
2. Second firing for flesh-painting.	600	1112	Beautiful rosy tint when the color is thin; when thick, it is apt to be a little bricky....	Increasing in brightness.*
3. First firing for flesh-painting which is also the second firing for flowers....................	700	1292	Greatest heat for fritted porcelain, the subsequent firings must be lower.. ...	Brighter red.
4. First firing for flowers (feu d' ébauche).....................	800	1472	Pink slightly purplish..............	Still brighter red—cherry red.
5. Gilt bands (filets d' or) gilding on the white porcelain or on the..	900	1652	A bluish tone which becomes fainter and dulled or spoiled as the temperature increases	Cherry red.
6. Hard kiln colors (decorator's high fire colors)......................	950	1742	Tints growing fainter and duller........	Brighter cherry red.
7. Fire for dead gold (or mat)......	1000	1832	All the tints, whether rosy or purplish, have almost entirely disappeared.....	Bright cherry—about the melting point of silver.
8. Gold melts about...............	1200	2192		

*Many soft glazes, such as that for fritted porcelain, soften about 600° to 700° cent., and the fritted porcelain glaze generally liquifies at 1,000° cent.

Paintings on porcelain often require three or even more firings; and, as these should be very carefully graded for fine work, it is impossible to have them done properly except by a firer of experience. In this country it is better to prepare the work, if possible, for only one, or at the most two, firings. Figure-subjects, on account of the delicate iron-reds employed, should have their first firing at a lower temperature than that for flowers, and the second should be at a still lower temperature, or else the flesh reds either lose their freshness, or entirely disappear. For ordinary decorations such precautions are not necessary.

The baking usually lasts from three to four hours, and the muffle should be allowed to cool very gradually. When taken out, the pieces should never be placed on marble, stone, or any other cold substance, but on wood, as any sudden change of temperature is apt to cause them to crack. A current of cold air will be apt to have the same effect. It is better to have the paintings thoroughly dry before they are put in the muffle.

Paintings on the glaze of *earthenwares* are treated in much the same way. Those on soft porcelain (fritted paste) admit of more firings, sometimes as many as five or six, which must be conducted with the greatest care, by a very experienced firer, 700° Cent. being the greatest heat allowed. See table.

Coarse potteries are sometimes decorated by dropping paint or slip on them while very moist, and so obtaining peculiar tree-like forms and mottled effects. The slip is generally very liquid, and is put on by a thing looking very like a tea-pot, which process is called moco-ing. Pottery is also decorated by metals in their natural states, used either in gilding or as lustres.

Gilding.—Gold, platina, silver, and occasionally copper, are used for this purpose, being either finely pulverized, or else dissolved in acid, and then precipitated.* In either case, the powder thus obtained is mixed with its flux, oxide of bismuth, and used as a paint over the glaze. When fired it is dull, and has to be burnished. At the French Exhibition of 1878, there were some remarkable decorations in a sort of transparent gilding, in golds of different colors on colored backgrounds. The pattern in this is first put on with oxide of aluminium, and then the gold put over it. Underglaze gold backgrounds of a peculiarly magnificent effect were shown by Deck, and also underglaze patterns in gold by Parvillée. The glaze in these two last must, of course, melt at a lower point than the melting point of gold.

Lustres are films of metal so thin that they often become iridescent. For gold lustre the metal is dissolved, precipitated, and mixed with turpentine without any flux. It is applied with a brush over the glaze. When fired it shines with a bright metallic lustre, but does not wear well. Platina lustre is nearly the same, only giving the silvery shine peculiar to that metal. Silver is not much used, as it is

* See note 10, Appendix B.

apt to blacken. Other lustres are the **Burgos**, or Burgau, or mother o' pearl lustre, made from sulphur, gold and potash. The copper lustre on Moorish wares, and on some majolicas, is much the same in appearance, only rather more purple. It has been reproduced successfully of late, as have also the magnificent ruby and other lustres formerly used. The **Cantharis**, or cantharides lustre was very brilliant, but is now seldom made, owing to the difficulty of its manufacture. It was made from lead-glaze, bismuth and silver, and the difficult part of the process was the exposing of the hot ware to the smoke of burning animal and vegetable substances giving green, reddish, yellow, and blue tints. A common ware, made principally in Germany, has a lead-lustre, yellow, blue and green. Very beautiful iridescent or firework lustres, for both glass and porcelain, are now made, and the iridescent effect can be produced on or in different colors. The processes are too long and too complicated to be described here. **Jules Brianchon**, of Paris, is particularly noted for these. A porcelain from **Belleek**, Ireland, has a very pretty silvery, or pearly iridescent lustre.

Very beautiful effects are produced by **Etching on the Glaze**; done either with hydrofluoric acid (which is also used to remove desperate errors in porcelain painting), or else with a wheel such as is used by engravers on glass. The Wedgwoods do particularly fine work with the acid, producing very delicate and beautiful effects peculiar to themselves.

Émaux Ombrants.—This name is given to wares in which the pattern is impressed or hollowed out so that the deepest hollows represent the darkest shades, while the lightest parts are in high relief. The whole design is then filled up evenly with a transparent colored glaze, which being thicker in the hollows is naturally darker there, while the reliefs having only a thin coat of glaze on them are much lighter in tone. When well done the effect is soft and pretty.

Lithophanie.—Brongniart gives this name to the porcelain biscuit transparencies so often seen as lamp-shades, etc. In these the pattern is so arranged that the dark parts are the thickest and the light the thinnest, thus being exactly the opposite of the *émaux ombrants.* They are made of a very translucent biscuit, and when the light is behind them, the thickest parts intercept it, and so form the shadows, while the thin, allowing the light to pass through, form the high lights of the design.

BROGNIART'S CLASSIFICATION.

Brogniart regards as primarily essential the characteristics of the paste, and as secondary those of the glazes; and he divides all pottery into three classes and nine orders, as follows:

1ST CLASS—Soft body pottery—paste easily scratched by iron. Argillaceous (*clayey*) sandy, calcareous (*with lime*) fusing at the heat of the porcelain kiln.

Earthenware.	1st Order, Terra-cotta	Paste, argillaceous—sandy—unglazed surface—divided into..	Plastic articles (la plastique), cast. Utensils (bricks, furnaces, etc.), cast. Unglazed pottery (mate), jars, urns, etc.—made on wheel................	This last is subdivided into four groups, according to color.
	2d Order, Lustrous pottery..	Coarse earthenwares.	....Thin silico-alkaline glaze (*silica, potash or soda*)	Paste homogeneous, fine, loose texture, more or less colored. Surface shining from thin vitreous covering or glaze.
	3d Order, Varnished pottery		.......................Plumbiferous (*with lead*) glaze.	
	4th Order, Enamelled pottery		......................Stanniferous (*with tin*) glaze................	Opaque paste, colored or whitish—soft loose texture.

2D CLASS.—Hard body pottery, *i. e.* cannot be scratched by steel, opaque, argillaceous, sandy, infusible.

Earthenware.	5th Order, Fine earthenware (faïence fine)	Colorless paste. Glaze plumbo-vitreous (*of about the same composition as flint glass or crystal and consequently having a little lead in it*).	
	6th Order, Stoneware (Grès cérame)	Colored paste. Unglazed, or with silico-alkaline glaze	Divided into coarse and fine. Paste dense, hard, more or less opaque—sonorous.

3D CLASS.—Hard body translucent pottery, argillaceous, sandy, alkaline, softens in baking.

Porcelain.	7th Order, Hard porcelain	Paste, kaolin and feldspar (*petunse*). Feldspathic glaze	No lead or tin in glaze.
	8th Order, Natural soft porcelain (English)	Paste, argilo-saline, kaolin, phosphate of lime. Glaze plumbo-vitreous, boracic.	
	9th Order, Artificial soft porcelain (French)	Paste, marno-saline—fritted. Glaze plumbo-vitreous—crystalline.	

Brogniart divides glazes into three classes:

1. Varnish—vernis.—Every vitrifiable substance transparent and plumbiferous, which melts at a low temperature, generally inferior to that required for the paste.
2. Enamel—émail.—A vitrifiable substance, generally stanniferous.
3. Couverte—no English equivalent.—A vitrifiable substance which melts at a temperature equal to that of the baking of the paste.

These divisions are generally observed in French works on pottery. Salvétat retains them in many cases.

PART III.

DESCRIPTION OF WARES.

CHAPTER IX.

CLASSIFICATION.

To M. Brongniart's classification, which regards as primarily essential the characteristics derived from the paste, and as secondary those derived from the glaze, there are a good many objections. These are obviated in the following table by Salvétat. In Brongniart's table moderately soft potteries, such as some ball clays, have to be classed among hard potteries. Stonewares, too, have all kinds of glazes, which should not be confounded in one and the same order. There seems to be no place for new products; such, for example, as lead-glazed porcelains, parian, feldspar pastes, etc. M. Salvétat makes two grand divisions, one, *unglazed* or *simple* pottery, the other *glazed* or *composite* pottery. Each of these classes is subdivided into *opaque* and *translucent*. All **Translucent** potteries have certain common characteristics, inasmuch as they are always *very hard*, and are almost always *perfectly white*. On the contrary, **Opaque** potteries present very considerable differences. The *color varies very much;* some are *soft;* some are *hard*, and some are *very hard;* these last forming the grade between soft pottery and translucent pottery. In some cases the difference between potteries is only one of temperature, so that one and the same composition of paste may at different degrees of heat present the characteristics of all the different potteries. The paste of **Hard Porcelain,** when very slightly baked (*faible dégourdi*) is *soft*, when more baked (*tres fort dégourdi*) it is like some earthenware, a *hard* pottery; when the temperature is just below that necessary to soften pegmatite, it is *stoneware;* and, finally, at a temperature of 1500° to 1600° Cent. (blue-white heat), it is **Porcelain,** the hardest pottery of all. Moreover, very different ingredients, such as those used for hard and for soft porcelains, may result in biscuits very much alike in appearance. In order accurately to classify these, it is necessary to have *sub-orders*, qualifying the hardness of the paste, and *genera*, to which the principal or necessary ingredient of the paste gives its name. The first class stops here, as it only refers to biscuits or unglazed wares. Persons unwilling to study these tables, should read carefully what is said about composite pottery and glazes. In the second class, **Composite** or **Glazed** pottery, each *genus*, that is each kind of paste, has five or more *species*, according to the composition of the *glaze*. New species can be added when required. Some of the examples given of glazes have only been experiments that have not had any commercial success.

It will be noticed that this table is very elastic, allowing the admittance of new genera and species as needed, and naming each genus and species according to its distinguishing characteristic. It also coincides well with the usual division of pottery into *earthenware*, *stoneware*, and *porcelain;* and the expressions *coarse* and *fine* can, when needed, retain their place as characterizing the preparation of the paste. When for any reason it is necessary exactly to identify any particular ware, it is very easy to do so. Majolica, for example, is coarse lime-body, tin-glazed earthenware. To characterize a ware often confounded with this, we simply change the name of the glaze to "colored lead-glazed." Iron paste, salt-glazed stoneware, with the prefix fine or coarse, describes kitchen ware, or else some of the fine ornamental ware made in England, another variety of which would be feldspar-body, borax-glazed. When necessary, bone phosphate body, borax-glazed porcelain is easily distinguished from either feldspar body, feldspar-glazed, or fritted body, lead-alkali-glazed porcelain. Certain Eastern wares are coarse sand body, lime-glass-glazed earthenware. Flint-body, lead-glazed earthenware describes the old c. c. ware; and if great exactness should be needed, *feldspar*-flint-body, borax-glazed, would describe the ware oddly called opaque porcelain. Semi-porcelain is a term that might perhaps be used instead of fine earthenware in speaking of the wares intermediate between opaque and translucent ware, when such wares are slightly translucent. Such questions settle themselves in practice, but with our convenient language we have no excuse for ambiguity in such matters.

Glazes are made either with or without lead. Both borax and tin glazes have a little lead in them, but are never classed as lead-glazes. Glazes in general can be classed under the following heads, which, when necessary, can be sub-divided as needed. (The list of bodies and glazes—genera and species—could be made much larger and fuller than that given here, but would take up too much room, while it would only be of use to the manufacturer or dealer).

1. **Lead-Glaze.**—This includes a large number of glazes, from the unwholesome glaze, with a very large proportion of lead, used on some very coarse potteries, to the glaze of *old Sèvres*, and the first *Wedgwood* ware. This last has nearly the same composition as the well-known intensely brilliant flint-glass or crystal (potash-lead-silicate). The term *flint* should not be understood as meaning *hard*, for this is really a soft and fusible glass : the silica for it was formerly obtained from flints, whence the name. Flint-glass, with still more lead, is strass, the composition used in making artificial gems. The name **Alkaline-Glaze** is often given to lead-glass, or flint-glass glaze, but is hardly distinctive enough. If used, it would be better to add the prefix lead—all glazes being more or less alkaline. Zinc, thallium, and other metals will make a very brilliant glass.

Boracic Glaze.—Much the same in composition as flint-glass glaze, only with borax, or boric-acid added, which greatly increases the hardness and the brilliancy. Boric-acid is much used now in glazes, instead of borax.

Tin-Glaze.—This may be considered a lead-glaze, made opaque and white by the addition of oxide of tin, which also renders it harder and less fusible.

Silica-Alkali.—The salt-glaze used on stone-wares is the principal glaze of this nature. It is a soda-glass. The lustre on some ancient potteries would come in here, as analysis proves it a potash-glass.

Earth-Alkali.—This includes feldspar and other natural glazes, besides artificial ones that might be classed as *lime-glass-glazes*. Feldspar may be considered as a natural glass, rendered very tough and strong by the alumina in it. Lime, sand (silica), and other ingredients are added to feldspar as needed. At Sèvres a rock (pegmatite) consisting of a natural mixture of quartz (silica) and feldspar is used without any addition. In China a petro-silex (uncrystalized or compact feldspar), mixed with pure lime is used. A very thin transparent glaze is often called a lustre.

SALVETAT'S TABLE.

CLASS I.—UNGLAZED OR SIMPLE POTTERY.

ORDERS I, II.

ORDERS.	SUB-ORDERS.	GENERA.	EXAMPLES.
ORDER 1. Opaque Body ...	SUB-ORDER 1. Soft body .... (Pâte tendre). Earthenwares.......	1. Hydrated (with water) charcoal body (Pâte charbonneuse hydratée).	1. (The insufficient baking has not driven out all the water.) Savage, Celtic, Madagascan. Some Etruscan and Peruvian pottery.
		2. Quartz body (quartz in rather large pieces), (Pâte quartzeuse).	2. Much primitive pottery. Gallic, Scandinavian, and others. Very coarse modern pottery.
		3. Sand body (naturally fine sand), (Pâte sableuse).	3. Egyptian and Assyrian pottery. Terra cotta, bricks, tiles, etc., ancient and modern.
		4. Marl body (lime added as marl), (Pâte marneuse).	4. Roman and Greek pottery. Some terra cotta.
		5. Lime body (with at least ten per cent. of lime generally added as chalk), (Pâte calcaire).	5. Coarse earthenwares—flower-pots, etc.
	SUB-ORDER 2. Hard body (demi-dur lit, half-hard.) Earthenwares... ..	1. Charcoal body (made black by charcoal), (Pâte charbonneuse).	1. Bourzy pottery. Some primitive potteries.
		2. Ball-clay body (Pâte argileuse).	2. Pipes. Some ornamental potteries. This ware is often called pipe-clay (terre de pipe).

SALVETAT'S TABLE.—Continued.
CLASS I.—Unglazed or Simple Pottery.
ORDERS I, II.

	SUB-ORDER 3. Very hard body........ (Pâte dur). Genus 1, Fine Earthenwares. Genera 2 and 3, Stonewares........	SUB-ORDER 3. 1. Flint or silex body (Pâte silexée).	1. All wares with calcined flints and often feldspar, such as opaque porcelain, granite-ware. Fine earthenwares (cailloutages, faïences fines).
		2. Iron body (Pâte ferrugineuse).	2. Coarse stonewares. Also some dark-colored, but very well-made Chinese and Japanese stonewares, (grès cérame.)
		3. Feldspar body (Pâte feldspathique).	3. Fine stonewares. Some Wedgwood-ware.
ORDER 2. Translucent Body..	NO SUB-ORDERS. Always very hard body Porcelains.	1. Kaolin body (Pâte kaolinique).	1. Hard porcelain—unglazed.
		2. Bone or phosphate body (Pâte phosphatique).	2. Bone porcelain; also called Natural or English soft porcelain—unglazed.
		3. Fritted body (Pâte frittée).	3. Artificial soft porcelain. Old Sèvres, unglazed.
		4. Feldspar clay body (Pâte argilo feldspathique).	4. Parian and similar bodies.
		5. Feldspar body (Pâte feldspathique). 6. Petro-silicious body. (?)	5, 6. Porcelain buttons, artificial teeth. Also, probably, many Chinese and Japanese porcelain biscuits; although they perhaps would class more exactly as petro-silicious body.
		7. Lime body. These may be added if required.	7. Nymphenburg porcelain.
		8. Magnesia body.	8. Some Piedmont and Spanish porcelains.

CLASS II.—Glazed or Composite Pottery
ORDER I.—Opaque Body.
Sub-order 1.—*Soft Body.*

Genera. Bodies.	Species. Glazes.	Examples and Notes.
Nos. 1 and 2. (The hydrated charcoal, and the quartz body are never glazed.)	1. Lead-glaze (Plombifère.)	Also called plumbiferous, plumbeous, alkaline.
	2. Boracic-glazed. (Boracique.)	
	3. Tin-glaze (Stannifère.)	Also called stanniferous.'
	4. Silica-alkali (Silico-alcaline.)	Salt-glaze or saline-glaze.
	5. Earth alkali. (Alcalino terreuse.)	
No. 3. Sand body.	1. Lead-glaze	Lead glazed bricks—coarse earthenwares.
	2. Boracic-glaze	Coarse earthenwares. Some Persian potteries in which tincal is used.
	3. Tin-glaze	Arabian and Persian earthenwares. Some of these, with sufficient heat, make porcelain.
	4. Silica-alkali	Small Egyptian figures, also many lustrous Roman potteries with iron in glaze.
	5. Earth alkali	Some Arabian potteries, and some modern potteries with lime-glass glazes.
No. 4. Marl body. (Some lime.)	1. Lead-glaze	Coarse glazed earthenwares.
	2. Boracic-glaze	Coarse glazed earthenware. Much of this is of very good quality.
	3. Tin-glaze	Tiles for stoves and some decorative work. Not so good for this glaze as lime-body.
	4. Silica-alkali 5. Earth-alkali	Nearly all the fine ancient Roman and Greek potteries belong to 4 and 5 and have a very thin glaze or lustre that sometimes seems potash and silica (the silica very likely from the body of the ware), or else a glaze with a little lime or even iron, never any lead.
No. 5. Lime body. (At least 10 per cent. of lime.)	1. Lead-glaze	Coarse glazed earthenwares. The glaze is often colored.
	2. Boracic-glaze	Common crockery, etc. The paste has often to be modified for this glaze.
	3. Tin-glaze	Earthenwares. Persian, Delftware, Majolica, ancient and modern.
	4. Silica-alkali 5. Earth-alkali	These glazes do not answer on this body unless it is modified.

CLASS II.—GLAZED OR COMPOSITE POTTERY.

ORDER I.—OPAQUE BODY.

SUB-ORDER 2.—*Hard body.* SUB-ORDER 3.—*Very hard body.*

GENERA. BODIES.	SPECIES. GLAZES.	EXAMPLES AND NOTES.
	SUB-ORDER 2.—*Hard body.*	
(No. 1. Charcoal paste, is never glazed.)	1. Lead-glaze	Faïence d'Oiron. Some Palissy ware. This was the first fine earthenware, and had *sand*, not flint, in it.
No. 2. Ball-clay body.	2. Boracic-glaze..	Decorative potteries. Ware made by Regal and Sanejouand.
	3. Tin-glaze......	Some Palissy ware. Palissy used but little tin in his glaze.
	4. Silica-alkali.	
	5. Earth-alkali...	Tiles, bricks, etc., with either lime-glass glaze, or glazes from slag, basalt, etc.
	SUB-ORDER 3.—*Very hard body.*	
1. Flint body.......	1. Lead-glaze....	Original Wedgwood cream-colored ware.
	2. Boracic-glaze.	Fine earthenwares, modern c. c. ware, granite-ware, etc.
	3. Tin-glaze	Fine Lunéville earthenware. Decorative wares.
	4. Silica-alkali...	Some Elers ware, glazed by volatilization.
	5. Earth-alkali...	Some fine modern wares, with lime-glass glaze.
2. Iron body	1. Lead-glaze....	Decorative stonewares in Europe. Some coarse stonewares.
	2. Boracic-glaze..	Good domestic stonewares, which often have baryta in the glaze.
	3. Tin-glaze	Chinese and Japanese stonewares.
	4. Silica-alkali...	Nearly all coarse stonewares. Some Doulton ware, salt-glazed.
	5. Earth-alkali...	Stonewares, glazed with slag.
3. Feldspar body...	1. Lead-glaze....	Mostly decorative stoneware, glazed by volatilization.
	2. Boracic-glaze..	English stonewares.
	3. Tin-glaze	Chinese stonewares. These are almost porcelains.
	4. Silica-alkali...	Fine stonewares. Doulton ware, salt-glaze.
	5. Earth-alkali...	Fine stonewares. Sometimes a good deal of lime is used.

CLASS II.—GLAZED OR COMPOSITE POTTERY.

ORDER II.—TRANSLUCENT BODY.

NO SUB-ORDERS.—*Very hard body.*

GENERA. BODIES.	SPECIES. GLAZES.	EXAMPLES AND NOTES.
No. 1. Kaolin body.	1. Lead-glaze	Some decorative porcelains. Some Chinese porcelains—(if they belong to this genus).
	2. Boracic-glaze......	Sèvres hard porcelain in imitation of Palissy ware. Some fine decorative porcelains.
	3. Tin-glaze..........	Some decorative wares, also some Chinese porcelains.
	4. Silica-alkali	The salt glaze does not answer well on porcelain.
	5. Earth-alkali.......	Sèvres, Dresden, American hard porcelain. Feldspar or lime-glaze.
No. 2. Bone-phosphate body.	1. Lead-glaze .... (Flint-glass glaze.)	Old English porcelains—now generally have borax glaze.
	2. Boracic-glaze......	English porcelains.
	3. Tin-glaze.	
	4. Silico-alkali	This may be applied by volatilization.
	5. Earth-alkali.......	Lime-glass glaze, very hard.
No. 3. Fritted body.	1. Lead-glaze .... (Flint-glass glaze.)	Old Sèvres porcelain. Limoges porcelain.
	2. Boracic-glaze......	Much modern porcelain, generally household ware.
	3. Tin-glaze..........	Chantilly porcelain was covered with a tin glaze to hide the colored paste.
	4. Silico-alkali	Some Persian porcelains are glazed with sand and the alkali from the ashes of a plant.
	5. Earth-alkali.	
No. 4. Feldspar-clay body.	1. Lead-glaze	Parian. This is very like bone-phosphate porcelain.
	2. Boracic-glaze......	Parian made into all sorts of articles, decorative and useful.
	3. Tin-glaze.	
	4. Silico-alkali.	
	5. Earth-alkali.......	Some Parians have a glossy surface from the fused feldspar.
No. 5. Feldspar body No. 6 (?). Petro-silicious body (China).	1. Lead-glaze	Chinese and Japanese porcelains. It is not yet certain whether these porcelains belong to this genus.
	2. Boracic-glaze......	Some decorative work.
	3. Tin-glaze..........	Some Chinese porcelains.
	4. Silico-alkali	Porcelain buttons. Some are made of pure feldspar, others of feldspar and bone phosphate.
	5. Earth-alkali.......	Chinese porcelains are glazed with a petro-silex mixed with more or less lime.
No. 7. Lime body.	Earth-alkali	Nymphenburg porcelain.
No. 8. Magnesia body.	Earth-alkali	Spanish and Piedmontese porcelains.

CHAPTER X.

SOFT POTTERY.

PASTE OPAQUE, POROUS, AND MORE OR LESS COLORED.

Soft Pottery may be divided into essentially soft and accidentally soft, the former being made of clays which from their constitution will only admit of a small degree of heat without fusing into a shapeless mass, while the latter would include all potteries that are soft from insufficient baking. According to Brongniart's table as usually given, soft potteries are rather difficult to classify specifically; though all kinds are fully described in the course of his work.

Soft pottery may be either **Glazed** or **Unglazed.**—All *primitive potteries* belong to this class, and many of them were decorated by colored clays fixed to the body or to the glaze by means of a slight degree of heat.

Ware of this nature has been made at all times and in all countries, even among the most barbarous tribes. Much of this primitive pottery is good in form and pleasingly decorated. Some of it is so slightly baked that all the water is not driven out of the clay and the paste is very soft and friable. (See table, Chap. IV., Nos. 1, 2, 4, 6, 7, 8, 9.) Others are well baked. Fired-clay is one of the most indestructible substances known, and the remains of pottery are found in good condition in the oldest and most dilapidated ruins, and also in the lake dwellings in Switzerland and elsewhere.

European Pottery—Ancient—*Glazed* and *unglazed.* **Greek Pottery.**—This term generally includes not only pottery made in Greece, but all potteries made under Greek influence. It now seems pretty well proved that the Greeks themselves received their knowledge from Egypt and from the East. The Greeks were excellent potters, thoroughly understanding the composition of good paste, and also the use of the wheel and of moulds. They paid particular attention to the form of their vases, and in their finest pottery the curves have that delightful balance and sobriety that this nation shows in all its best art work. A number of beautiful and spirited figures or statuettes have lately been found at **Tanagra,** which were made in moulds and afterwards touched up by hand, particular attention being paid to the head. Little accessories, such as hats, etc., were modelled and added afterwards. Some seem to have been glazed, and many colored.

There is a whole literature on the subject of Greek vases, and the different vessels are classed as follows by Dennis:

Class 1.—Vases for holding oil, wine or water—amphora, pelice, stamnos.

Class 2.—Vases for carrying water—hydria, calpis.

Class 3.—Vases for mixing wine and water—crater, celebe, oxybaphon.

Class 4.—Vases for pouring wine, etc.—jugs, œnochoë, olpe, prochoüs.

Class 5.—For drinking cups and goblets—cantharus, cyathus, carchesion, holcion, cyphus, cylix, lepaste, phiale, ceras, rhyton.

Class 6.—For ointment or perfumes—lecythus, alabastron, ascus, bombylios, aryballos, cotyliscos.

Note—The names are often written *kylix*, *keras*, etc.

Etruscan Ware.—From the circumstance that ancient vases were first found in *Etruria*, the name Etruscan was given to all vases found in Magna-Græcia and other colonies in Italy. Most of these vases are clearly of Greek manufacture, being made by Greeks settled in Italy, and are now correctly called Italo-Greek. The finest Greek or Italo-Greek vases were polished or lustrous, the decorations very simple in color, but very fine in design and execution. The colors were principally a dull brick red, a black, and a brownish black, produced by the red body showing though the thin coat of black over it. The Greeks occasionally used a few slips, bright brick red, purplish red, yellow and white; and yet, with dull colors and a coarse kind of paste, they made some of the most beautiful pottery the world has ever seen. Some Greek vases are brightly colored, but these are very rare. The Greeks used terra-cotta a great deal for bas-reliefs, etc.

The **Etruscans** proper had a style of their own, and made very large pieces of pottery, some of it very curious and of very queer shapes. They also, like many other nations, used pottery for their coffins. Many analyses have been made of the Italo-Greek, and of Etruscan pottery, the regularity of the results in both cases showing that the potters had regular recipes to work from. In much of the ware, owing to both iron and lime being present, the paste would be too fusible to allow of much heat being used in the baking.

The **Romans** were very good potters, but never equalled the Greeks, as regards the decorative part of the potter's art. They, however, encouraged good keramic art and obtained their best pottery from Etruria, Magna-Græcia and other places. The finest Roman ware was the so-called **Samian Ware** of bright red color, with fine, close, rather hard paste, and thin clear glaze, generally ornamented with incised or relief patterns or mouldings. Terra-cotta was used for many architectural purposes.

Lustrous Potteries.—Some of the Greek and Roman ware is remarkable for the fine, thin, hard transparent glaze or varnish, called a *lustre*, that covers it in part or entirely, the composition of which was unknown for a long time. (See table, Chap. IX.)

This *lustre glaze* must not be confounded with the *metallic lustres* used on some wares. In Roman pottery it generally covers the whole surface. In the Greek it often is used decoratively only in parts. The color varies from black to bronze, and even bright red, this latter proving the presence of iron (sulphuret). All of the above pottery may be classed as marl or sand body, and some of it is both fine and hard. The glaze is silica-alkali. (See table, Chap. IX.) All the other nations of Europe made pottery more or less good, most it being made under Roman influence, and following the same methods.

America.—Very good pottery has been found in aboriginal America, and some of it seems to have a glaze analagous to the lustrous ware just described. Much ancient American pottery shows great skill in the workmen, as there are no traces at all of the use of either wheel or moulds, and many of the shapes, some of which are good, others grotesque, are very difficult to make. According to Germaine de Poligny, there is a strong resemblance between Mexican keramic art and that of the borders of the Mediterranean, so much so that he thinks it gives us reason to suppose the races are nearly allied.

Asiatic and **African** pottery.—The *Phœnicians, Egyptians, Babylonians*, and *Assyrians* were all good potters, particularly the last three, who understood the composition of colored glazes or enamels of fine quality. From them, through the Persians, the

Arabians probably derived their knowledge, which afterwards was brought to Europe either by Spain or by Majorca. The Egyptians had a peculiar fashion of glazing or enamelling soapstone (steatite), and also a very gritty, hard paste which Salvétat thinks may have been a natural sandstone (*grés*) and not a made paste. This last has been erroneously called porcelain—*the Egyptians made no true porcelain.*

The discoveries of late years of the numerous early potteries in **Cyprus, Asia Minor,** and elsewhere have completely upset the old ideas of the genesis and development of Greek and other ancient pottery, and have made, particularly as regards the influence of nations on each other, a complete revolution in the history of pottery. History in general has also been aided in determining many disputed points in chronology. The whole subject is intensely interesting, but can only be glanced at here. It can be studied to a certain extent in Birch, Jacquemart, Brogniart and other writers, and to a less degree in any good general history of pottery. Prime and Young both have interesting chapters on early American pottery.—See also "The Scientific American," for an interesting series of articles, beginning March 29th, 1879.

Modern Pottery.—Common unglazed ware, as flower-pots, is made of clay compounded with sand, or with the same pottery pounded fine. The paste has but little preparation, though for the better quality of ware it is washed and ground in a mill, and generally made on the wheel. As it does not soften in baking, and has no glaze, the pieces can be piled up in any way in the kilns. Although this pottery is made almost everywhere, it is not good for most household uses on account of its porosity; but this very quality renders it valuable in many warm countries where porous vases, named *alcarazzas* in Spain, and in India called *monkeys* by the English, are used to cool water by evaporation. In some countries sawdust is mixed with the clay and burned out in the baking, thus leaving the vessels very porous. Slightly baked porcelain makes an excellent alcarazza, and has the advantage of not communicating to the water the clayey taste given by the earthenware ones. Very pretty fine pottery of this class is now made for ornamental purposes, generally in imitation of Greek forms. In this the paste, which is usually reddish or yellowish, is carefully prepared, and being very plastic can be fashioned on the wheel, cast or modelled.

The same earthenware as just described, only with a transparent lead-glaze, is the **Coarse Earthenware** or crockery made almost everywhere. The coarsest wares of this kind, those which are generally found in country districts, bake at a very low temperature, and have a very fusible glaze. Owing to the large proportion of lead, and to the fact that it is easily affected by acids, or even by hot grease, this glaze is exceedingly unwholesome. When, however, the paste is well compounded and well baked, and is an agreeable color, and the glaze has only a small proportion of lead; a handsome and useful household ware is the result. Borax, and even feldspar, are now extensively used in glazing the best coarse wares, thus rendering them perfectly wholesome. The glaze is often colored, generally yellow or brown, and sometimes a slip of finer clay is put on under the glaze, so disguising the ugly tints of the paste. For the better class of wares the paste has often finer clay put in it, and is washed, run through sieves, and dried in a slip-kiln; that is run through a trough of heated bricks. This ware has usually two bakings, one for the paste, and one for the glaze, and is often packed in seggars. In some very common wares, one baking suffices, the glaze, which is almost all lead, being dusted on as a powder.

This whole class of ware is generally known as coarse or common earthenware (Fr., *faïences communes*,) and when not further specified is understood to have a transparent glaze. Most of this pottery is marl body, more or less fine and hard, though some of it approaches in composition the fine earthenwares. Owing to the recent great improvement in manufacture, many wares, such as c. c. ware, that in old times would be classed as fine earthenware, are now relegated to the coarse ones.

Much of the ware made by Palissy and his imitators belongs to this class, though in some of it the body is almost as hard as that of the fine earthenwares. Bricks, tiles, and various kinds of architectural ornaments are made in this ware, and are often glazed.

Eastern nations make a variety of lead-glazed earthenwares, in many of which the paste is white, and only belongs to the soft potteries on account of its insufficient baking. Some glazes without any lead in them have been used on this pottery by the Arabs and Persians. Other wares are covered with transparent or translucent colored enamels. These are sometimes used on incised or on raised patterns and the effect is very good (*Fr. emaux ombrants*).

Mezza-Majolica.—*Lime body—lead-glaze.*—In Italy this ware preceded the true majolicas, and is of importance from an artistic point of view, and also because it is a good example of decoration by a slip or engobe. The earthenwares with transparent lead-glaze, just described, though a great advance on unglazed pottery, were unsuited to fine painted decoration of any kind, because of the ugly color and coarse texture of the paste. This objection was first obviated in Europe by the use of a slip, which was dried or baked, then painted, and afterwards covered with a lead-glaze. The principal colors used were yellow, blue, black, and green. The slip itself was sometimes colored, and the painting was done by means of various colored slips. In still another style of decoration the pattern was scratched or etched on the slip, so that the darker color of the body showed through the glaze, which in the Italian wares was generally colored. This style was called **Scraffito** (lit. scratched) ware. Both of these often were enriched by metallic lustres.

A revival and development of these methods is shown in the potteries made by M. Bouvier, and decorated with slips of different colors, in which the design is scratched or etched. Many decorative earthenwares made principally at Limoges and at Bourg-la-Reine, in France, can also properly be described here, as they are *lead-glazed earthenwares* of more or less hard body, and in decoration are really a revival of and an improvement on slip-painting, which is one of the very oldest methods of decorating pottery, slips or engobes having been employed from very early times. The modern method* originated with Messrs. Laurin, Chaplet and Lafond in 1873, at Bourg-la-Reine, where it is still carried on by M. Laurin. Messrs. Chaplet and Lafond were employed by the Havilands at Limoges, who are now particularly famous for their use of this style of decoration done at Auteuil under the supervision of M. Braquemond. Beautiful effects are produced in various ways, the transparent lead-glaze giving great depth and beauty to the colors, which are also often improved by the use of borax, particularly the blues. Figures are carved or modelled in unglazed paste, and used on glazed and colored vases. All such work, when not perfectly well done, is very disagreeable. This slip-painting, and other processes

* See Chap. VIII., page 78.

more or less resembling it, are used by many famous French potters, the details of paste and glaze being naturally kept secret. The pottery varies in color, and very much in hardness, and the decoration hides the body. The most noted French potters for the new decorative ware, besides those mentioned, are Deck, who shows gold *underglaze* backgrounds, very rich in effect, Collinot and Parvillée, nearly all of which potters also make the tin-glazed pottery described in the next chapter. Attempts at slip painting are being made in this country, but as yet most of it is only groping in the dark. A peculiar style of slip painting has also been used for some time in Switzerland, and much curious work similar in character is done in Russia. Eastern nations use both this and the following methods of decoration:

Tin-Glazed or **Enamelled Earthenwares.**—*Coarse earthenware*, with a *stanniferous*, or *opaque tin-glaze*, is esentially the same ware as the Italian majolica and the Delft ware made in Holland, and at Rouen and Nevers in France, and many other places. It has a *whitish* or *colored porous soft paste*, which being coarse in quality requires but little preparation. It is plastic, and can be thrown, pressed, cast, or modelled by hand. The opaque tin-glaze, or rather enamel, is generally made of calcine, that is, lead and tin intimately mixed and calcined 47, sand 47, carbonate of soda 3, sea-salt 3; these proportions as usual varying with the different potters, and other matters being sometimes added. The tin renders the glaze *opaque* and *hard.* The more tin there is in the glaze, the harder, the whiter, and the more expensive it is; the more lead, the softer, cheaper, and more unwholesome it is. This glaze may be either white or colored, but in either case completely hides the coarse body of the ware. The composition of both paste and glaze varies slightly in different countries, but includes always a good deal of lime in the paste. The paste does not soften in baking, and so can be supported in the kiln or seggars by cock-spurs and the like. Owing to the difficulty of making the glaze adhere to the raw paste, this is generally first baked at a temperature varying from cherry red to whitish red. The tin-glaze is then applied, and, in the old majolicas and wares similarly compounded and arranged in the kilns, the glaze was baked at a higher temperature than the body. In such household ware as is generally made now, the reverse is the case.

Some of the better kinds of kitchen ware belong to this class, dishes and bowls often being white on the inside and colored on the outside.* The outer color in American ware generally is buff or brown. Jugs, pitchers, tea-pots, and the like can be seen in any crockery shop, and a broken piece will show the coarse body and thick opaque glaze. In France and Germany tiles and plaques for stoves and chimney pieces are made of this ware, and handsomely decorated with patterns in relief, or incised, which, when covered with a white or colored tin-glaze, have

* See note 12, Appendix B.

an excellent effect. In fact, all kinds of figures and ornaments can be made. This ware readily lends itself to the most artistic decoration. When the tin-glaze is hard enough, almost all the *regular kiln colors* can be used over it, but the effect is apt to be harsh. When the colors are made expressly for this ware they differ slightly in composition from those used on procelain.

Painting in the *gloss-oven colors* on the unbaked glaze is extremely difficult to do, and requires great skill and experience, the powdery glaze very easily rubbing off and being excessively absorbent. But the effect of the work when well done is very fine, glaze and color being thoroughly incorporated. (See Chap. VIII.)

The most famous enamelled earthenware is that known as **Majolica** or **Maiolica** (the pronunciation is the same in Italian), which is the Italian name given to tin-glazed earthenware. This ware probably was first used by the Arabs or Persians, and was introduced by them into Italy through the Balearic islands, of which Majorca is one, whence the name, Majorica, subsequently softened into majolica. To this day there are potteries in Majorca, lineal descendants of these old ones, still making wares decorated very much in the Arabian style. At one time the term majolica was only applied to the *lustred wares* of *Spain* and *Italy*, but now it is used for decorated tin-glazed earthenware dishes, ewers, and other articles made in Italy during the renaissance period, and also to modern wares reproducing or imitating them. The most famous majolicas were made at Urbino, Gubbio, Castel-Durante, Pesaro, and other places in Italy. Lucca della Robbia, whose name is often given to this ware, takes precedence of all other decorators, as, though he does not seem to have invented the tin-glaze, he was the first to bring it to perfection in Europe. His majolicas and others owe their great value to their beautiful decorations, both in colors and in metallic lustres, which last have never been equalled. During the time when majolica was at its height, great artists were employed to decorate it, copies also were made of many of the most famous paintings by Raffael and others. It was even said that Raffael himself painted on majolica, but there is no proof of this. **Raffael Ware,** or Raffael majolica, is not that decorated with copies of the great master's pictures, but that which is ornamented with arabesques, scrolls, and similar designs.

Delft Ware.—This enamelled earthenware was celebrated for the beauty of its bluish-white tin-glaze, and for its good decoration. Formerly there were in Delft from 150 to 200 potteries making this ware, and now there is not one.

Tin-glazed earthenwares were made in Europe, Asia, and in many other places than those mentioned here, all the wares presenting more or less the same characteristics. For a long time, such ware, either plain or decorated, was the best table-ware known, but it has been almost entirely superseded by fine earthenware, and by porcelain, both being more suitable for this purpose. After the invention of porcelain, the manufacture of artistic earthenwares of all kinds ceased almost entirely. An attempt has been made to revive them in our day, but with what permanent success remains to be seen. Tin-glazed is also called ***enamelled earthenware*** in many works (*faïence émaillée*).

Henri II. Ware—Faïence d'Oiron.—This remarkable ware, of which there are only about 67 pieces in existence, deserves an especial mention. Though utterly unconnected with the invention of them, it may be regarded as the precursor of the *fine earthenwares.* The body is of ball clay, and perhaps a little kaolin. This is covered by a thin layer of a finer and whiter clay, in which the decoration is cut out or engraved, and is then filled in with colored clays, the whole being glazed with a *transparent lead-glaze.* Both potting and decoration are perfect of their kind. The origin of this ware long remained unknown. The fact is now ascertained that it was made under the direction of Hélène de Hangest, widow of Arthur Gouffier, at the chateau d'Oiron, about 1524. The best was made during her life, and that of her son; after that it deteriorated. Fac-similes of some of this ware were to be seen at the Centennial in the English Exhibit. A full and interesting account is given by Jacquemart, both in his History and in his Merveilles de la Céramique, and it has been made the object of many special studies. It forms a curious and instructive episode in the history of pottery. See also Chaffers.

Faïence d'Oiron ware can neither be classed as soft nor as very hard, but with some Palissy ware, and some other ball-clay, often called pipe-clay wares, takes an intermediate place as hard (*demi-dur*) *ball-clay-body, lead-glazed earthenware.* Some of the Palissy is the same body, tin-glaze, while some modern decorative wares are *borax-glazed.*

NOTE.—A very pretty ware made and decorated by Miss McLaughlin of Cincinnati is now attracting much attention. In general effect it resembles the slip-painted Limoges ware, being decorated in much the same style, but is said to have a harder body and glaze.

CHAPTER XI.

VERY HARD POTTERY.

Hard or **Very Hard Pottery** is so named from the fact that the paste is very hard, and, expect in some stonewares, is either perfectly white, or nearly so. This pottery is divided into **Fine Earthenware, Stoneware** and **Porcelain.** In the last two there is a commencement of vitrification which renders the body *dense* or *impervious* to *liquids.*

It must be noted that the modern earthenwares, the stonewares, and porcelains run into each other by almost imperceptible gradations, the porcelains being the most distinct group, owing to their *translucence.* The distinctions between the wares were formerly much more evident, but of late years such great improvements have been made, both in paste and in glaze, that much of the accepted classification is very arbitrary, and more a matter of convenience than of fact. When, however, the main ingredients of paste and glaze are known, each ware can be definitely classed, and if needed new genera and species can be added. It would save trouble if manufacturers would adopt some system, instead of adhering to names that often mislead as to the character of the ware.

Nearly all of the wares described so far have been, for table and other domestic use, entirely superseded by the **Fine Earthenwares** (*faïences fines*), the paste of which is white, opaque, sonorous, or ringing, more or less porous, and consequently adheres more or less to the tongue. These wares all spring from improvements upon the original ware made of ball or pipe-clay alone, and which has been hardened by the addition of flint (*silex*), and later of feldspar and kaolin to the paste, making it white and able to stand a high temperature in baking, while the original soft lead-glaze has been hardened and also rendered more brilliant by the use of borax and boric-acid. The principal difficulty in the manufacture of this ware is not so much in obtaining a good body as to find a glaze suitable to it, and which shall never craze. When well made this is, next to porcelain, the best ware yet made for domestic use. The principal objection to it, is that when cracked or nicked, the paste, being porous, absorbs grease, and is easily discolored. In many wares now made this objection is obviated to a great extent by the introduction of feldspar, which, partly melting, makes the body more dense.

The glaze is now almost always boracic, but in some few cases a *tin-glaze* was used. A lime-glass glaze can also be used, as can a feldspar glaze, when the body is hard enough to stand the necessary heat. All kinds of articles for various sanitary and manufacturing purposes are now made of this ware, and new applications of it are made every day. The best wares of this class were invented and brought to perfection in England, beginning with Astbury and Wedgwood, and coming down to our own day. By French writers the title ordinarily applied to fine earthenware is *faïence fine* or *faïence anglaise*. Sometimes the word *cailloutage* is used. The first title is always given, however, if there is danger of ambiguity. The opaque *tin-glazed earthenware*, or majolica, is called either **Faïence** or **Faïence Emaillée,** while the coarse *transparent* glazed earthenwares are called *faïences communes*. In many English works of good standing, these wares are confounded together in a very bewildering manner, it being sometimes stated that the opaque tin-glaze is always used on *faïence*, fine or coarse. This confusion probably arises from the apparent similarity of the names in French, sufficient attention not being paid to the qualifying words. In English there seem to be no generally accepted names among authors, faïence sometimes meaning faïence fine, and sometimes meaning tin-glazed ware or majolica.

The historical c. c. (*cream color*) ware, made by Wedgwood, and afterwards named **Queensware** in honor of Queen Charlotte, was formerly classed among the fine earthenwares, but c. c. ware is now placed among the better kinds of coarse earthenware. The fine earthenwares now made have various names, such as *granite-ware, iron-stone, semi-porcelain, stone-porcelain, opaque-porcelain;* some of these having kaolin, Cornish clay, and often feldspar in the paste, lead the way to English porcelain. The distinguishing characteristic of fine earthenware is the introduction into the paste of flints, the best of which are found in chalk-pits; these are calcined, and ground to an impalpable powder, which is very white. The proportion of flint is about one-fifth—say, eighty clay, twenty flints. Part of the clay may be replaced by carefully washed kaolin, and feldspar may partly take the place of the flints. The recipes vary very much in the different potteries. These wares will generally class as **Flint-Body Borax-Glazed Earthenware.**

The paste, according to its quality, goes through some or all of the processes described in the chapters on manufacture, and being very plastic can be pressed, thrown, or cast. It is baked twice, first in biscuit, and then for the glaze. As the paste does not soften in baking, the articles can be piled up, one on another in the seggars. The biscuit is generally absorbent enough to be glazed by a dip. In the glaze baking, which is at a much lower temperature than the paste baking, the pieces are suspended on thimbles and pins, cock-spurs, stilts, or other contrivances. The points of contact are made as small as possible, but can almost always be found. The bottom rims are generally glazed. The French for some time made a ware of this kind, which though fine and white was much *softer* than the English, both in paste and glaze. This being objectionable, a tin-glaze was tried, which made a handsome but expensive ware. This was practically given up, and the English methods and compositions adopted. Excellent ware is made at Montereau or Creil, Choisy-le-Roi, Bourg-la-Reine, Chantilly, and other places. When French clays alone are used, both paste and glaze are apt to be softer than the English.

Decoration.—Being very plastic, the paste of fine earthenware can be moulded or pressed into any ornamental forms, and will also admit of the richest color decorations by all the methods used in decorating porcelain both over and underglaze, the latter being particularly good in effect. The colors for the last must be prepared especially for the ware on which they are intended to be used, so as to suit the fusibility and composition of the glaze which varies considerably. (See Chap. VIII.) All the regular kiln colors can be used on the harder glazes, as such glazes do not soften at all at the low heat required for firing these colors. Beautiful effects are produced by painting on or in the glaze before it is baked, color and glaze then melting together. For ordinary use this ware is ornamented by patterns printed either under or over the glaze; sometimes only the outlines are printed, and the patterns then filled up by hand. Decoration on fine earthenware should be bold and striking in style. The color of the ordinary ware is apt to be spoiled by too much blue in the glaze, this being designed to correct the yellowish tint of the paste; a tint that is very agreeable in itself, and that needs no disguise.

Common **Tobacco Pipes** are made of much the same paste as that of fine earthenware, but are baked at a lower temperature, and are not glazed. They are baked in kilns very ingeniously arranged.

Excellent pottery of this kind is made in this country where all the materials are found in abundance. Some of these potteries are remarkably fine in texture, and are capable of delicate finish. The decoration with a very few exceptions is poor in design and crude in color. A visit to any of the large potteries, such as those at Trenton, or at East Liverpool, Ohio, will show all the modern improvements.

Within a comparatively short time, there has arisen a whole class of beautiful decorative pottery, rather difficult to classify, which comes more or less under this head. The paste is generally *very hard, but not always very white*, with a *transparent* lead, borax, or even feldspar glaze, in this last case the sulphates of lime and baryta being used in conjunction with pulverized flint glass. All of these glazes are sometimes colored, producing effects resembling those very often found in Eastern ware. Wares of this sort are made at Limoges and elsewhere in France, by the potters mentioned on page 117, and also by Boulenger at Choisy, who has discovered the hitherto hidden secret of *rouge flammé* or *flambé;* by Massier, and by O. Milet (Sèvres). There also are famous potteries at Creil, Montereau, Longwy, Gien, Sarreguemines, all having styles of their own, and all worth careful study and comparison; a remark applying also to the English wares of this class, some of which are wonderfully fine, being bold and original in treatment. The Minton and Lambeth or Doulton earthenwares or faïences are well known, also the Wedgwood. Some of these deserve most careful study. A little ware something in this style is made in this country, but as yet calls for no very particular mention, though there is hope for the future. All this ware is generally spoken of as faïence, and called after the various potters who make it, or after the places in which it is made, the names being often mixed up in the most remarkable way by dealers.

Tiles and **Plaques** are also made of fine earthenware and decorated by hand or by printing, offering great resources to the keramic artist.

CHAPTER XII.

VERY HARD POTTERY.

STONEWARE.

Stoneware (Fr. *grès cérame*), sometimes called *grey ware*, has a compact, hard, vitreous, dense, sonorous paste, often hard enough to strike fire like flint. The paste is generally colored, and is composed of a fusible and an infusible element. When baked together at a great heat, the fusible element melts and envelops the infusible, forming a mass with *no porosity* at all; thus differing essentially from all the pottery before described.

Stonewares are divided into *coarse* and *fine*, having characteristics in common, and only differing in quality. **Coarse Stoneware**—such as butter-pots and vinegar-jugs—is made by the wheel or in moulds from very plastic clay. There is a good deal of sand in it, and the flux is iron or lime, or both. The paste goes through but little preparation: stones and other impurities are picked out; it is then wedged. In parts of Europe and the East, it is trodden. In this country, both the good quality and the cheapness of stonewares have much increased since adoption of an *endless rack mill*, in which the paste is ground and riddled ready for use.

Sometimes the clay as found has all the necessary properties: sometimes clays from different localities, one *refractory*, the other *fusible*, are used. More lime and sand are often added. When the paste is too plastic, ground pitchers (Fr. *ciment*), that is, the baked ware pounded fine, is used, though sand generally answers this purpose.

No particular precautions are necessary in arranging the wares for baking. The coarser sorts are generally placed on shelves, or in divisions of the kilns, or are even piled up, only separated by "*slugs*"—rolls or pieces of sandy clay—while the finer sorts are more carefully arranged. The baking requires a high temperature and a great deal of fuel and may last from two days to a week. The paste when baked is so compact that it really needs no glaze; nevertheless it is glazed, both for appearance sake and also because in coarse or badly-made ware the body is full of little holes and cracks caused by the irregular contraction of the pastes in baking. All stoneware, from butter-pots up to fine Doulton ware, can be glazed in a way peculiar to itself. During the first and only firing, when at white heat, sea-salt is thrown into the kiln (many potters claim that the salt from salted cod-fish is the best, which may be so on account of the phosphate). The intense heat decomposes the salt (*chloride of sodium*), and the chlorine escapes as vapor, but the soda, meeting the white-hot ware,* takes from it a portion of its silica and makes a *silicate of soda* or *soda glass.* This is the perfection of glaze, being thin, transparent, and intensely hard. A method somewhat analagous to this consists of smearing the inside of the seggars with a mixture of salt, soda, and minium, which is volatilized by the intense heat, and with the silica from the ware itself forms a thin glaze. Other methods, used in Europe, of glazing common wares are: 1. By dipping it into ochre and water before baking, which gives a sort of glaze more or less yellow or brown, according to the degree of heat and the quantity of ochre. 2. By pulverized slag from iron works, either refining cinders or blast furnace cinders, the latter being very fusible on account of the large proportion of lime, while the former are composed almost entirely of silica and iron (*protoxide*). Lime, sand or clay is added if necessary. The dried ware is dipped in water, and then dusted over with the mixture, after which glaze and ware are baked and are generally of a rich chestnut brown.

Drain pipes are sometimes made of stoneware, which seems to possess all the qualities essential for such a purpose. Coarse stoneware of excellent quality is now made in this country, and is often given a black glaze in whole or in part, by means of the Albany dip. (See page 30.) It is very interesting to watch the making of stoneware on a common

* Which must be very silicious in order to glaze well.

wheel. All coarse stonewares, and some fine, are classed as iron-body, and generally salt-glaze.

Fine Stoneware is simply stoneware made with great care, and is excellent in every way. The composition of the paste varies. Feldspar is often added, rendering the ware *more fusible*, so that it bakes at a lower temperature. The feldspar then takes the place of sand as anti-plastic. Kaolin is also used—impure kaolins containing iron serving the required purpose, making a ware that in many respects resembles porcelain. In fact there is a great variety of ware, that runs into porcelain at one end, and into the hard earthenwares at the other. It generally can be classed as feldspar body. The clay and other materials go through nearly all the operations described in the chapters treating of manufacture. The glaze is generally a salt-glaze like that used for common stonewares, and this is so thin that it does not interfere with the most delicate ornament, either sunken or in relief. The feldspar stonewares really require no additional glaze. The feldspar fusing in baking gives them a sufficient gloss; nevertheless they are often glazed with glazes such as those used on the fine earthenwares, and even with the feldspar glaze of hard porcelain, either with or without lime. Fine stonewares are often first baked a soft biscuit, and then glazed by a dip. The unglazed fully baked stoneware is called *dry-body* by potters. The paste is so plastic that it can be fashioned in any style, and all impressed or embossed ornamentation can be made very sharp and clear.

It is to Wedgwood that we owe the .perfection, and almost the invention, of much of the beautiful modern stonewares to which he gave the name of *basalt*, *jasper*, *onyx*, and the like. In some cases it is difficult to distinguish the pastes from porcelain biscuit, the only difference being in opacity. These pastes are colored with various oxides, the number being limited on account of the heat required in baking; blue, orange, green, black, brown, and their combinations are the principal colors available. These oxides augment the fusibility of the paste, and as this extra fusibility must be corrected by some other ingredient, the compounding of fine pastes requires the greatest care and skill. Most of the original moulds for Wedgwood's delicate wares were made by Flaxman, the ground being often of a different color from the ornament. Much of this kind is left unglazed. It is impossible to attempt any great amount of detailed description, owing to the great variety, both of ornamentation and of the composition of the paste. Remarkably fine stoneware is now made at Lambeth, England, and is known as **Doulton** ware, from the name of the makers. This is generally salt-glazed. Besides the usual styles of ornamentation, some of it is decorated by spirited designs scratched or etched in the unbaked paste, which is then glazed. The Doultons have added several colors to the old list, and are continually improving the character of the ware.

The *kaolin* or *feldspar* stonewares, and all those with softer glazes than the salt-glaze, admit of a large range of color decoration. This can be put on very thickly, in the style of the Japanese and Chinese stonewares, which are often ornamented with raised enamels on brown or yellowish bodies, or on a slip either white or colored. Sometimes the whole vase is covered with a tin-glaze and then painted. Böttcher's first attempts at porcelain really resulted in a fine reddish-brown stoneware, and as he did not know how to glaze it, it was simply polished. The Elers made an almost similar ware in England; first red, like Böttcher's ware, then yellowish white, but with a genuine salt-glaze. This ware was very fine in texture, and had delicate embossed ornaments made in copper moulds. The old stoneware known in a general way as **Grès de Flandre** was very beautiful in form, decoration, and color of paste, which varied from whitish to brown and light grey; this last being sometimes decorated with embossed ornaments, and colored in blue and purple. Much of the finest ware was made at Cologne, and in other German cities; at Creussen, in Bavaria, and at Beauvais, France.

Very fine stonewares, mostly iron-body, are made in Japan and China, and decorated with enamels. Stoneware is often covered with a layer of porcelain and then decorated. There is also a most delicate stoneware, called **Buccaro**, or boccaro, which is superior to any European stoneware, and is decorated with colored enamels raised a good deal above the surface. The fine Japanese stonewares known as **Satsuma** and **Awata** are made of a very refractory porcelain clay which undergoes hardly any fusion. The glaze is composed of feldspathic materials, and lixiviated wood ashes (potash), and when cooled always presents a net-work of fine cracks. At Awadje is made a stoneware remarkable because it is glazed with a soft lead glass. **Banko** ware, called after its inventor, is made in the province of Ise, and resembles Wedgwood. It is made of extremely tough and plastic brown clay, in all sorts of fantastic forms, and is decorated by paintings in opaque enamels. Some of it is light in color, and some wares are mottled by mixing the two colors.

A good fine stoneware is made at Trenton, N. J., the coloring of the paste being particularly agreeable in many cases.

CHAPTER XIII.

VERY HARD POTTERY.

PORCELAIN.

Porcelain differs from all the before-described potteries in being translucent. The paste is *dense, vitreous*, intensely *hard*, and *white*. The derivation of the word seems uncertain. It is supposed to be derived from a bright shining shell (*cowrie*) called porcellana by the Portuguese; but it is found in use in Europe before the introduction of porcelain, and then seems always to signify some very precious substance. Marryatt suggests a species of agate, perhaps chalcedony, which resembles porcelain in its milky hue and semi-translucent character, and from which the name porcelain may have been transferred to the new substance introduced by the Portuguese. Pure white porcelain of the best quality, has a wonderful charm in its milky translucence, and in the East the white porcelains, when perfect, are prized over all others. Fine earthenwares do not possess this beauty, and they, as well as the tin-glazed earthenwares, are suited to rich, magnificent decoration hiding the surface of the ware. It looks too often as if the worker on porcelain forgot this, and tried to compete with the gorgeous effects instead of endeavoring to adorn and develop the peculiar gem-like beauty of the translucent porcelain, not covering it up by opaque masses of color, but rather putting translucence on translucence. Both French and English porcelains have, of late years, imitated or copied Eastern and particularly Japanese work, and the result has been good.

In almost all works on pottery this ware is divided into **Hard-** and into **Soft-Body Porcelain,** which, though looking much the same, differ in composition of both paste and glaze. The hard has more alumina and less silica, and owing to the great heat required for baking is more dense in texture. The soft bakes at a lower temperature, and its alkaline fluxes (potash and soda), with an excess of silica, render it much more fusible. The use of the terms *soft* and *hard* is rather bewildering here, and it is a pity some other expression is not used. The term soft is used in two senses, first as meaning *more fusible*, secondly, as meaning that the ware or rather the glaze, is more *tender, and can be scratched by a steel point.* **Soft Porcelain** is *hard* pottery because the paste or body cannot be scratched. It is *soft* porcelain because both paste and glaze are much more *fusible* than those of hard porcelain; and also because the glaze can *easily be scratched with a file or a steel point*, which will make little or no impression on that of hard porcelain.

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When this test cannot be applied, it is often difficult to distinguish between the two kinds. Marryatt relates how the learned M. Brogniart, being presented with a choice specimen of old Worcester, affirmed it to be oriental porcelain, till he tested the glaze with a steel point, and found it would scratch easily. The glaze, moreover, of soft porcelain seems more velvety to the touch, and looks oily. It is very lustrous, also it usually covers the bottoms and bottom rims, which in hard are almost always left unglazed.

Old Sèvres gives a good type of the softest porcelain; next come the English porcelains, then the Chinese, and the hardest of all are the German and the French hard porcelains. In date of invention, however, they range as follows: 1. Chinese; 2. European soft porcelain; 3. European hard porcelain.

Hard Porcelain is the household ware with which we are all familiar, and which, no matter where made, is commonly sold in shops as French porcelain, or French china. Like stoneware, it is composed of a *fusible* and an *infusible* element; this last, which is *opaque*, enabling the porcelain to stand the heat necessary to vitrify the fusible element which is *transparent*, or nearly so. Kaolin makes the plastic, opaque, and infusible part of the paste to which it gives its name, and for ordinary porcelain is often used as found; but for delicate wares much of the sand found in it must be washed out. The fusible and nearly transparent substance is either pure **Feldspar** or pegmatite, often called petuntze, or a mixture of sand, chalk and feldspar, which, melting and enveloping the kaolin, gives the porcelain the translucence that is its distinguishing characteristic. The preparation of these materials requires all the precautions possible, and varies according to the quality of the kaolin. They first, and the paste afterwards, go through *all* the operations described in the chapters treating of manufacture, many of them being repeated several times. The paste is *not very plastic*, but is enough so to be *thrown*, *pressed* and *moulded* by skilful workmen, large articles being usually made in several pieces. The ware is first slightly baked or biscuited, so that being still porous, it can be glazed by a dip. As it does not soften in this first or biscuit baking, it can be piled up in the oven or seggars without any unusual precautions being taken.

Glaze.—This is almost invariably made of feldspar or pegmatite (Cornish stone). It is used either alone, as at Sèvres, or with the addition of a little kaolin quartz, or carbonate of lime, or an artificial lime-glass may be used. Glaze and paste are baked together at the highest temperature used in pottery baking: equal to the melting point of wrought iron, or from 1500° or 1600° Cent. (2700° to 2980° F.), to sometimes 1800° Cent. (3272° F.) After baking, the glaze should be perfectly even and brilliant, intensely hard, and with no spots. The paste, softening slightly in the final baking, has to be supported propped and placed with the greatest care, and all kinds of ingenious contrivances are used for this purpose, it being generally necessary that support and piece shall be of the same paste, so as to contract equally. The articles scarcely ever rest on the bottom of the seggar, but stand on *setters* of paste or clay, the glaze being wiped off of any points of contact with seggar or supports, which are sprinkled with an infusible powder in order to prevent the parts sticking together. The rough edges left in this way are now always ground off, and even polished on a lathe. In old porcelains they were left on rough. Attempts have been made to apply other than feldspar or earthy glazes to hard porcelain. The salt-glaze of stoneware does not answer well, owing probably to a want of silica. Good effects are produced by the use of soft lead-glazes, or of different soft enamels applied on the hard biscuit, all of which, on account of the lead, are objectionable, except for purely decorative purposes.

Statuettes and figures of all kinds are made of a porcelain biscuit, differing slightly in composition from that of the ordinary ware. Such figures are usually cast by means of slip in closed moulds, and are very difficult to support and bake without distortion. In their manufacture very careful calculation is required as to contraction, the paste shrinking a good deal in drying, and still more in baking. They are sometimes glazed, but the effect is seldom good. The unglazed figures, and also vases, are occasionally decorated with colors without any gloss which is accomplished either by putting very little flux in the paint, or by mixing finely-pulverized porcelain biscuit with it.

Decoration.—Porcelain can be decorated by all kinds of color-ornament, by gilding and by lustres. Owing to the intense heat required for the baking, the gloss-oven colors are few in number, consisting of cobalt blues, chrome greens, iron browns, manganese browns, titanium yellows, uranium blacks and yellows, platina greys, and a red or rose from gold, besides a few other substances that have hardly yet taken a definite place in decoration. It may be noted that the chrome colors when mixed with the paste utterly destroy the translucence of the porcelain, thereby converting it into fine stoneware. The above colors and their combinations are necessarily the underglaze colors for hard porcelain. They are seldom used except for backgrounds, but most lovely effects can be produced by their use as paints on the white porcelain biscuit, the milky glaze giving a wonderful softness and tenderness to the effect, which can be strengthened by overglaze touches or by gilding. All of the regular, and also the hard kiln colors, can be used either on the glaze or on the underglaze colors, as also gilding of all kinds, and some of the lustres. Lustred porcelains are often very pretty, particularly those with the nacreous or pearl lustre, but it is a style of decoration that is apt to be overdone, and is then meretricious in effect.

Very beautiful effects are obtained with hard kiln colors by the *méthode Richard*, and also by *pâte-sur-pâte*, or *slip painting*. (See pages 74 and 86.) Very fine specimens in both styles were shown at the French Exhibition of 1878, where also were to be seen porcelain from Limoges, which in whiteness and delicacy of paste rivalled the Sèvres wares. From Sèvres were sent cups with the paste pierced in patterns, and the holes filled up with colored enamels. Wonderful applications of slip-painting, both in white and in colored paste, were also shown, as well as some remarkable effects obtained by the use of tin-glaze over the body, somewhat in the Chinese style. For interesting reports of all this see the "Gazette des Beaux Arts," for 1878; also the "Art Journal," and "l'Art," for the same year.

The **Saxony** hard porcelains are very famous, both for fine quality of paste and of decoration. **Meissen** and **Dresden** are other names for the same ware, the latter being perhaps the best known name in this country. This ware has deteriorated, but *vieux Saxe*, or Old Dresden, is as famous in its way as *vieux Sèvres*. It must be remembered that it is a hard porcelain, and so is decorated in an entirely different way from the old Sèvres, which was soft. Hard porcelain of the finest quality and decoration is made at Sèvres, Paris, Limoges, Vienna, Berlin, Capo di Monte, and many less noted places, and experiments of all kinds are conducted with more or less happy results. A porcelain which deserves an especial mention on account of the materials employed was made in some parts of Italy and in Spain. In this the infusible element, instead of kaolin, is a magnesite. Brogniart calls this **Hybrid,** or mixed porcelain. Paste made in this way is very refractory, but has little plasticity, and is difficult to work; it also shrinks very much. In Spain magnesite was used, in Italy (*Piedmont*) giobertite, both being much the same mineral. At Nymphenburg, Bavaria, a lime porcelain is made, in which gypsum and quartz are used instead of feldspar. (See table of pastes).

Hard porcelain is made in this country, where all the necessary materials can be found. So far the ware has been good in quality, but very poor as regards decoration. The first serious attempt at making it was in Philadelphia, by William Ellis Tucker, about 1825, a fact still commemorated by the name of a little street. Since then hard porcelain has been made in various parts of the United States, principally at Greenpoint, N. Y.* Mr. Smith of the Union Porcelain Works at that place, writes: "Our glazes differ from those generally used (in Europe). * * As far as I have been able to learn, they almost universally use feldspar in their glaze ; I do not use it, for the reason that I get a harder and more durable glaze without it, and I burn at a higher heat than they do, in fact a stronger fire than

* While I write, a project is on foot for establishing a large porcelain pottery in Philadelphia.

is good for a feldspar glaze." He adds: "We use no metallic oxides to flux the glaze. We use nothing but simple earths.

If our potters can be convinced that it is the artistic element that gives its highest value to pottery, and will procure the services of artists of talent, there seems no reason why in time to come we should not have good and well-decorated porcelain made in this country. *

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* In Miss Young's book there is an interesting, well written, and well illustrated, but not at all critical article on American pottery, and especially porcelain. See also Prime and Elliott.

CHAPTER XIV.

VERY HARD POTTERY.

CHINESE AND JAPANESE HARD PORCELAIN.

Chinese authorities state that the art of making porcelain was invented in China, about 185 B. C., in *Sin-Ping*, under the Han dynasty, and thence through the Corea it seems to have been transmitted to Japan, about 1592 A. D.

The Chinese in their catalogues and technical works make no distinction between stoneware and porcelain, considering the former as an inferior quality of the latter. Their best porcelains appear much the same in texture as the European hard porcelains, differing however, in the composition of both paste and glaze. Chinese porcelain paste, having a much greater proportion of silica, is more fusible than the fine European pastes, which are very aluminous, and consequently very hard. (See table, page 52.) The Chinese paste, and still more the glaze, will melt in the greatest heat of the European porcelain kiln; and this greater fusibility—allowing color effects denied to us by the great heat to which our hard porcelain is subjected—makes it worth while considering whether such intense heat in all cases is necessary. The finer Chinese and Japanese porcelains are wonderfully beautiful, are of the most delicate texture, and are very translucent. The Japanese porcelains seem to vary in hardness of body, while the glaze is not so closely incorporated with the body as in the best European wares.

Paste.—Chinese and Japanese, like European porcelain, is composed of a fusible and transparent and an opaque and infusible substance: the first is supposed to be *petuntze* (petrosilex*), the second *kaolin*.

Pe-tun-tze (lit., white brick, *tze* diminutive.) This name, as used in Europe, is applied only to feldspar in various forms, and is not strictly correct. In China it is given to any porcelain materials when put up in the forms of little bricks or blocks (*tun*), and is also given to porcelain paste or glaze ingredients, when mixed, dried and put up in this shape. The two terms, however, kaolin—meaning porcelain clay, and petuntze meaning feldspar, etc.—have definitely taken their place in keramic nomenclature in Europe.

According to careful investigations made at the time of the Centennial Exhibition, the finest Japanese porcelain seems to be made without the use of any

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* Petrosilex, compact feldspar—felsite. A petrosilex is not necessarily pure feldspar, but generally has quartz, and often other elements in it. In a pestrosilex or petrosilicious rock, the elements composing it are not crystalized or distinct, but are in invisible particles. In pegmatite these particles are distinct.

kaolin at all, or of any equivalent therefor, being compounded as to its body solely of petuntze-like or petrosilicious materials. The same thing has been suspected in Chinese porcelain, and it now seems a fair inference that most Chinese porcelains also have a strictly petrosilicious basis, and that the word kaolin is applied by the Chinese to a washed and pulverized petrosilex, and not to the clay we call kaolin. Baron von Richtofen, in a letter in the "American Journal of Science" for March, 1871, says: "The material from which the porcelain of King-te-Chin, is, or rather was, made, is a rock of the hardness of feldspar, and of a green color, like jade. [See table Chap. III., No. 6.] (The inferior kinds are not so hard.) This rock is reduced by stamping to a fine powder of which the finest portion is ingeniously and repeatedly separated; this is then moulded into *small bricks*. The Chinese distinguish two kinds of this material, both sold in this form. They are made at different places in the same manner, but the aspect of the rock is nearly alike in both cases. Formerly the best of these came from Kao-ling (high-ridge), but this place has lost its prestige for centuries: nevertheless the Chinese still call the best of these earths Kao-ling. The application of the name by Berzelius to porcelain earth was made on the erroneous supposition that the white earth he received from a member of one of the embassies, I think Lord Amherst, occurred naturally in this state. The same kind of material is called pe-tun-tze.'

The above statements open the way to much interesting investigation which would be out of place here; only it may be suggested that doubtless our potters can find in this country minerals suitable for making just such porcelains. Should the above investigations be proved correct, our kaolin clay porcelain would seem to be a new invention, which must be classed by itself as kaolin body, while the Japanese and Chinese porcelains would then be classed as either feldspar or petrosilex body as seemed most correct. In this connection it may be mentioned that much surprise was expressed by M. Paul Gasnault, Sec. Museum Dec. Arts, in the "Gazette des Beaux Arts," that the Japanese, in their exhibit in Paris (1878), stated that no kaolin was used in their porcelain, but only in faïence. M. Gasnault took for granted that the Japanese report must be incorrectly written or translated.

The first efforts in Europe to make porcelain from some Chinese materials brought there were unsuccessful, as only a fusible element, perhaps a block of glaze material, had been sent over by some missionaries, and as Father Ly, a Chinese Christian, quaintly says: "Some matters make the bones, others the flesh of porcelain. If kaolin (?) alone should be used for vases they would crack in the furnace; if on the contrary they were made of other matters without kaolin (?), being too weak to support the heat during twenty-four hours, they would dissolve in the fire, as flowers fade under the heat of the ardent sun." In the Histoire et Fabrication de la Porcelaine Chinoise, we have a clear and interesting account of all the processes connected with the manufacture of porcelain in China, which processes are essentially the same as those used in Europe, except that neither Chinese nor Japanese use steam power nor complicated machinery of any kind. In Japan, "the rock-like materials, quartz, kaolin, felsite, feldspar, or the peculiar porcelain stone of Arita, are pulverized by balancing pounders much the same as those used in China, a long horizontal beam with a perpendicular iron-shod piece like a hammer at one end and a water-trough at the other. These are worked by a stream of water, which running into the trough raises the pounder by over weight and running out at the end in consequence of the incline, allows it to fall down again with the iron-shod cross-piece dropping into a stone mortar in which the materials are reduced to powder." The Chinese also use little waterwheels, arranged on the banks of streams, and they recommend the Spring as the best season for grinding or pulverizing, as then the streams are strongest, and the pounding is better done. The waste is very great by this process.

Both countries use the **Potter's Wheel**, both with and without a flywheel. The potter generally sits with the head of the wheel coming up between his legs, while the motion is given by an attendant. In Japan the pivot on which the wheel turns rests on a piece of porcelain, thereby reducing the friction very much. They also use the **Potter's Lathe,** which in China was certainly in common use as early as 1368 A. D., and probably long before. Both countries also use clay moulds for paste (in Japan they are now adopting the use of the plaster mould), but not the closed moulds for slip, making, however, by other means, and by more difficult processes, vases and cups as thin as those made in Europe by this easy method.

Chinese and Japanese potters succeed in the most delicate effects of slip-painting, and of moulding or modeling on the body of the vase, and in carving patterns thereon with tools, also in all kinds of open or reticulated work, seeming to take pleasure in overcoming great difficulties of potting, and in spite of inferior tools, obtaining with apparent ease effects never yet reached by the European potter.

A very delicate style of ornamentation is obtained by punching out the pattern in the paste, the holes thus made being filled in by the glaze; this is called grains of rice. Cloisonnè enamel, in imitation of enamels on copper, the knowledge of which the Chinese derived from the Arabs, is also done on porcelain. The brass wire is fastened to the porcelain by means of melted glaze, and the enamels then applied as in metal work. In many cases the body is covered with a slip or layer of fine white clay or paste, which takes the color well. This method is also used in making the best crackled ware; in this the glaze is not crackled at all, but the slip being more or less contractile than the body or core of the vase, breaks into coarser or finer cracks. Coloring matter is rubbed into these, and the glaze is finally put over all. Hoa-chi—a sort of soapstone or steatite—is also used in this process. At the French exhibition there were some Japanese wares in which the decoration was delicately inlaid in the style of the Oiron faïence.

The **Glaze** used in China differs in composition from that generally used in Europe, which is almost invariably made of pegmatite or feldspar alone, and very seldom with a large amount of lime, while in China and Japan glazes with a large proportion, often as much as one-fourth lime, are the rule. In China *khi-men* or else yeou-ko,* a petrosilex chosen with as little iron in it as possible, and which is generally sold washed, crushed and put up in the form of pe-tun-tze, or little white bricks, is finely pulverized and mixed with water. This is added to lime which has been elaborately prepared by burning limestone and fern leaves in alternate layers. Salvétat does not think that the fern leaves have any very great effect, because in the first place so little of the fern ashes get into the glaze liquid, and in the second these ashes only contain a little silica, and a trace of phosphoric acid. Before adding it to the petrosilex, the mixture of lime and ashes is burned over several times, is carefully washed and allowed

* See analysis No. 6, table, Chap. III.

to settle, and in the end the ashes are thrown away; so that the object of the whole process seems only to be to obtain the purest lime possible. A fibrous gypsum (*chy-kao*) is also added, but the action of this seems to be merely to precipitate the mineral matters. The proportions vary, but for the best glaze are about ten of petrosilex and water (stone-oil) to one of lime and water (fern oil, lime oil). It may be well to mention here that in most of the works treating of Chinese pottery the technical term *oil* used in China for *glaze* or *glaze fluids* is literally translated *oil*, thereby making the descriptions wholly unintelligible to European readers, no oil being used either in the preparation of the *glaze*, or of its *ingredients*. It is said that in old times carnelian was used in glazes, carnelian being almost pure silica, and burning white, this might well be the case.

After the ware is thoroughly dried, but *not baked* at all, it is painted, and then glazed. The Chinese put on the glaze so as not to soften or break the ware, dipping it into the glaze liquid with great care, or else pouring the liquid over or into it. Very fine and thin wares will not stand these processes, and they have to be glazed by blowing the liquid through a tube covered with gauze. The bottom of the cup or vase is not finished, until the glaze and the painting are put on, but is left as a handle several inches long. This is then taken off, the bottom of the foot of the vessel is hollowed out, and a name or mark is often placed thereon. Certain cups or vases are often ground to a wonderful thinness on the lathe by means of iron tools, and some Chinese cups are apparently made only of the glaze, and are exquisitely thin. In the Histoire et Fabrication, it is said that in the finest of these, the paste is turned as thin as possible on the wheel, the glaze is put on thickly on the inside, and baked, and then the paste is ground away, leaving only the glaze or enamel as the cup. As a rule the Chinese leave the bases of their vessels rough, and in many cases take little pains to finish them off, differing in this respect from the Japanese, who are perhaps the best potters in the world. The Japanese porcelains differ slightly from the Chinese; the best are very delicate, and are very carefully finished off. They are also very translucent, owing to the fact that they have *more silica* and *less alumina* than any other hard porcelain. In Japan the glaze is always composed of a feldspathic material, either natural or produced by the mixture of different minerals, to which is added a certain quantity of lixiviated wood ashes, (potash lye,) the proportion depending on the place the pieces have to occupy in the kiln, the heat of which is not quite even. This glaze is put on by a dip, as in Europe, the ware being first slightly baked and then glazed. It seems strange that the Chinese should not have thought of this simple and easy method. It is just possible, however, that with such good potters as the Chinese, this may be intentional, and in order to obtain certain effects, and not the result of ignorance. This view is supported by the fact that in one part of China (see Histoire et Fabrication, book V. Page 128) it seems as if glazing was done as in Europe. In this connection an article in the "London Builder," by G. J. Morrison, M. Inst., M. E., copied into "Van Nostrand's Magazine," for May, 1879, is interesting, for it expressly states that the ornamental brickwork made at Lien li Ku, near Pekin, is *first baked* and then *glazed*. He also states that this brick will rank with the highest class of building material. This is valuable if the writer understands keramic processes, and has made no mistake. The article is also interesting in its description of the material—hard blue shale, as hard as slate, which is crushed by granite rollers and then used.

The Japanese **Kilns** are built on the slope of a hill, in a line of from four to twenty, the base of each kiln lying about three feet higher than that of the foregoing, so that if all the kilns were uncovered the whole of them would present the aspect of terraces formed by a series of platforms each three feet high, the kilns growing wider and wider as they extend up the hill. A draught is established through the whole line of kilns, which ends in a range of short chimneys corresponding to the draught-holes of the last kiln. There are no separate furnaces or fireplaces, but the fuel is thrown directly into the kiln, this being so arranged that the flame does not strike the porcelain directly, and is, besides, forced to take a circular or whirling motion. The kilns are fired in succession, beginning with the lowest; by the time this is finished the next one is red hot, and so on, thus effecting great economy in fuel. The placing and setting of pieces in the kiln is done in much the same way as in Europe, but comparatively few pieces are baked in seggars. The Chinese kilns appear to be constructed on much the same principle, only in China all the ware is packed in seggars, which has to be done with the greatest care, as the unbaked ware is extremely fragile. In both countries the firing is an especial branch of pottery, and the kilns are tended by men who do nothing else, and who consequently become very expert in this branch. The kilns are rented to the different manufacturers.

The list of colors used for **Decoration** is small compared to those used in Europe, as so far the Chinese and Japanese have not had the chemical knowledge necessary to produce many of our colors. They have some beautiful gloss-oven colors, among the most famous of which are the *céladon* and the *rouge flammé* or *flambé*, this last from the native protoxide of copper, requiring most careful management of the heat. They also have colors that resemble our hard-kiln colors in composition, such as violet, turquoise blue, yellow, and green. In China all underglaze painting is necessarily done on the *dried unbaked* paste, this requiring great skill and much practice. Both nations use gilding, and thoroughly understand all effects produced by more or less flux, or by a greater or less degree of heat applied to the color. Their regular kiln colors are nearly all enamels, and in composition and fusibility are very like the enamels used on metals. They are really lead-alkaline glasses, colored by a few hundredths of coloring matter dissolved in the glass. Salvétat and Ebelmen in their Memoir* give the composition of this flux or glass as silica, oxide of lead in slightly varying proportion (6 of minium, 2 of silicious sand, and 1 of borax), and a greater or less quantity of soda and potash. Japanese colors have much the same flux. The colors are few in number, consisting of copper for greens and blue-greens, gold for reds, cobalt for blues, antimony for yellow, arsenic and tin for white. Iron reds and manganese black, are also used; these last are not enamels, but vitrifiable paints. Black is usually obtained by bringing a color to its utmost intensity, or by placing two very deep colors over each other, as deep red over deep blue. The colors are not mixed with turpentine, but with water or thin glue, as used to be the custom in Europe. The artist adds a little lime or white lead, as he judges proper. Owing to the difference of paste and glaze, these Chinese over-glaze paints will not adhere on European hard porcelain, but crack off. The European vitrifiable paints, however, will generally answer well on Chinese ware.

* Annales de Chymie et de Physique (3) XXXI. 257, and XXXV. 312.

Before 1780 hard porcelain at Sèvres had a glaze somewhat resembling the Chinese, that is with a good deal of lime in it. Silica, 71.62; alumina, 17.50; *lime*, 9.38; potash and soda, 1.50. The colors in use at that epoch were really enamels, and consequently very like the Chinese colors. Since 1780 the glaze has been purely feldspathic, and potash takes the place of lime. Of late years at Limoges and at Sèvres, in France, porcelain has been made, which, owing to the composition of paste and glaze, can be decorated with enamels as Chinese porcelain is. Being enamels the Chinese colors are not at all intense in hue, for it must be remembered that the **Composition of Enamels** only allows a *very small percentage of coloring matter*. In their best work the Chinese do not shade their colors with other tints mixed with them as we do, but use them pure and generally flat. When they wish to produce a darker shade, it is usually done by increasing the thickness of the transparent enamel, or else by hatching, or going over the color with darker lines of the same. It may be mentioned here that both nations use opaque and transparent enamels on stonewares, producing in many cases very beautiful and curious effects. They also use soft lead-glazes and others on porcelain and stoneware biscuits, and color them. Lead-glazes were in common use in China in the tenth century. In fact they use *all* the resources of the potter's art.

According to the Japanese catalogue of the Centennial Exhibition, the **Flux** for Japanese colors consists of silica, litharge (red lead), and nitre (potash), forming a glass which is powdered, and to which is added either white lead or powdered silex, in order to increase or to diminish its fusibility. The coloring oxides consist of copper, manganese, antimony, red oxide of iron, impure oxide of cobalt (black), a sort smalt (blue) from China, gold reds, and gold for gilding, this last mixed with white lead or borax. All the ingredients are mixed by the painter himself and used directly. The whole design is traced in black lines, and the shades, if used, are only indicated by strokes. The colored enamels are put on in a thin layer when opaque, or in a thick layer when they are to produce, after melting, the effect of colored glass through which the black tracing of the design is visible. Sometimes relief paintings are produced by first coating the porcelain with a white opaque enamel, which contains no oxide of tin, but is merely a mixture of glass, white lead, and powdered stone, and on which the other colors are then applied. The Japanese also use lacquer in the decoration of porcelain, this substance is almost as imperishable as the vitrifiable paints, and so perhaps may be considered a legitimate keramic decoration.

The Japanese and Chinese, in common with all Eastern nations, are very fond of **Blue**, and much of their most beautiful ware is decorated with this color, generally under the glaze, which is apt to be slightly bluish. The Japanese get a very beautiful effect with underglaze blue, heightened with an overglaze blue.

In many instances Chinese overglaze colors, particularly blacks and reds, do not glaze at all, and the colors also often run into each other; but the Chinese do not regard this, as we should regard it, as a defect. For that matter much of the harmonious effect of Chinese, and, indeed, of much Eastern ware, is due to just such accidents. Salvétat, who on this subject is entitled to be heard with respect, suggests that much of the beauty of coloring in Chinese and Japanese porcelains is owing to their small list of colors, and to the fact that these being nearly all enamels, cannot be made very intense or glaring, so that the harmony results from necessity rather than from choice. However this may be, good color seems to belong to the Eastern nations. All through the East perfect knowledge of, and feeling for beauty of color seems instinctive; at least it has been so heretofore. In the various branches of the potter's art in Japan, and above all in China, the division of labor is carried to a great extent, and traditions and methods of potting, and of using the comparatively small list of colors, descend from father to son, each family devoting itself to some particular branch. The skilfulness and precision both of eye and of hand must be enormously developed by inheritance, so that in time it may be that this skill and precision become an instinct; and with his usual environment, it may be as impossible for the Eastern potter or colorist to make a mistake in his work as for a bird to build its nest wrongly. But it is quite possible, and unfortunately probable, that with the great changes going on in our day, and which seem to disturb the hitherto immovable East, breaking into its quietude with our steam-driven civilization, that the workman will lose his old and accustomed environment, and with it his instinct. After that it will be a very long time, if ever, before he will be able to reproduce his lovely harmonies by reasoning them out. Already we can see a change in the art-work of India and of Japan, both of which countries, and particularly the latter, seem to offer peculiar advantages for study and comparison. In spite of our boasted advantages, our influence in the East is undoubtedly bad as regards art, for our vaunted civilization does not flower out into splendid art, but develops more like the useful but ugly potato.

The great porcelain factory in China was at King-te-Chin; it was destroyed some time ago. Most of the porcelain from there was decorated at Nankin and at Canton.

The oldest Chinese pottery is very like stoneware, being hard, and covered with a thick and almost translucent enamel. The term céladon was originally given to wares of this kind, in which the glaze was colored a delicate sea-green, but has since been given to other shades. These are often decorated with raised or depressed patterns on the body, or with flowers (*céladon fleuri*). In the best céladon the glaze has a most delightful softness and smoothness, both to hand and eye, which as yet has never been equalled in Europe.

Although Chinese porcelain is always classed as hard, there are a few rare pieces in pure white, which seem more like the Persian soft fritted paste, and which are made with an alkaline fritt and silico-alkaline, not lead-glaze. The Chinese themselves place the highest possible value on white porcelains decorated with white, either as a paint, in which case there is a slight difference in tone between ground and decoration, or else the porcelain is ornamented with raised and carved designs in slip painting.

The Japanese have surpassed their teachers, the Chinese, and are now the best potters and decorators in the world. In delicacy of finish, in perfection and harmony of color and design, they are unsurpassed. The white of the Japanese porcelain is purer than that of the Chinese, and the blue is not so transparent. The paste is rather more fusible than the Chinese. Hizen, Owari, Kioto, Tokio, and Kaga, are the principal places for porcelain.

Corea.—Both China and Japan acknowledge their obligations to this country in the matter of porcelain. Genuine Corean porcelains have a remarkably pure white surface, and are very thin and delicate; the decoration is delicate and sober in color. The Chinese value them highly, particularly those shaped like lions and like gourds. No porcelain is made in the Corea now. Some of the porcelains attributed to the Corea by Jacquemart have since proved to be Japanese.

Porcelain, both hard and soft, was also made in **Persia.** Dates and authorities are in great confusion; but as new discoveries are made every day the whole subject may soon be settled. An effort was made to revive this industry in Persia not very long ago, but failed.

Genuine hard porcelain of fine quality was also made in **India**, but there are no very certain dates. The decoration on India porcelains is characterized by wonderful delicacy and minuteness of finish, both in figure and flower painting. All the details are worked out as in the finest miniature painting, while gold is employed with great skill and taste. The term **India Ware** does not mean porcelain from *Hindustan*, but was applied to Chinese porcelains brought from the East by the *East India Companies.*

CHAPTER XV.

VERY HARD POTTERY.

SOFT PORCELAIN.

Soft Body Porcelain is generally divided into **Natural** or **Bone,** and **Fritted** or **Artificial Porcelain,** the latter being almost entirely an artificial product, with no natural clay in it. **Old Sèvres**—this being the most famous soft porcelain—can be taken as a type of the artificial paste. It was the result of the efforts made in France to imitate Chinese porcelain. These efforts failed from the want of proper materials, but resulted in the making of a beautiful ware, which for purposes of color-decoration has never been surpassed. The manufacture began at St. Cloud, about 1695, and was transferred to Vincennes, and thence to Sèvres, where it was carried on until 1804, and then abandoned. This is what is generally called *Vieux Sèvres*. After 1804, for a time, only hard paste was made at Sèvres; but about 1847 the manufacture of the soft was revived, and since then both kinds have been made. The manufacture of old Sèvres was exceedingly troublesome, requiring great care and vigilance. The paste was composed of a clay-like marl, with a good deal of lime in it, and of a frit composed of sand, 60.0; nitre (potash), 22.0; salt (soda), 7.2; alum 3.6; dry carbonate of soda, 3.6; gypsum, 3.6; the whole was melted together into a kind of glass, then pulverized, and mixed with marl and chalk. This paste was ground in water for a long time, then dried, then broken up again, then mixed with water, with two parts of old paste to one of new. The glaze was a crystal or flint-glass, with a good deal of lead in it, fusible and easily scratched. (See Chap. VIII., page 75.) The paste not being plastic at all, had to be mixed with gum or soft-soap. The pieces were moulded roughly, and very much thicker than they were to be when finished. They were then dried, and afterwards shaped and thinned on a turning lathe with iron tools. The dust caused by this was very unwholesome, and was one of the principal reasons for abandoning the manufacture. The baking was very slow; it lasted for seven or eight days, and had to be conducted with the greatest care, with a clear flame with no smoke. The paste softened and shrunk very much, nearly a seventh, and it had not only to be carefully propped, but in some cases supported on moulds of the same paste, contracting at the same rate, and powdered over with infusible sand to prevent adhesion. This involved great waste, as the moulds could only be used raw or green, and consequently were useless after one baking. As this first baking was complete, the paste had no porosity, and the glaze had to be poured over it, or put on in powder, this being sometimes done twice in succession, and baked each time at a considerably lower temperature than the paste. The glaze had a richness, and a velvety softness to the touch, never obtained on hard porcelain. In the glaze bakings the ware not softening did not require supports, but each flat piece had its own seggar.

The great value of old Sèvres is due in part to its scarcity, but above all to the beauty of its painted decoration, often done by eminent artists. In all soft porcelain of this class, the overglaze paints, owing to the great fusibility of the glaze, sink into it, and incorporate themselves with it, producing incomparably lovely effects. The paste, too, is easily colored, and on account of the low heat employed there is a large number of gloss-oven colors. These are often employed to tint the glazes. In the case of old Sèvres, the colors of paste and glaze were often very beautiful.* Genuine pieces with authentic decorations are now very valuable, though much of the modern ware is as beautiful as the old. No perfect pieces of white ware are ever sold at Sèvres, but when the manufacture of soft porcelain was abandoned by Brogniart, about the year 1800, the stock on hand was sold, and pieces may still be picked up at times. Much of this stock was bought and decorated in imitation of that done in the fac-

* For regular kiln colors see Chap. XVI.

tory. An expensive fancy was imitating natural flowers in porcelain; an imitation generally very well done. Since 1875 beautiful soft porcelain has been made at Limoges. A commoner sort of soft porcelain is also made, which in France is in great request for household ware, and also for decorative purposes. Precautions are now taken in all the potteries to prevent the workmen from being injured by the dust. These porcelains all come under the head of *fritted body* with various glazes, generally flint-glass, and **Fritted Body Porcelain** certainly seems a better name than the one generally used. The paste of the **Persian Soft Porcelain** is very much the same as of the old Sèvres, but with a different glaze; this having no lead in it, being made of silica and the ashes of a plant that grows in salt lands, and which furnishes the alkali necessary to make the glass. As can be seen by the table, page 48, old Sèvres is a very silicious ware, even more so than the Japanese porcelains—being, indeed, in many respects more like glass than porcelain. At the last Paris exhibition (1878) some soft body porcelains were shown in which the colors, no doubt enamels, were put on in powder, and fused at a low temperature, producing a very beautiful effect.

The modern **English** porcelains are the type of natural soft porcelain, and, indeed, are the only kind made in England. All the materials necessary for the manufacture of hard porcelain are found in

England, nevertheless only bone porcelain is made. The English potters generally explain this by asserting that no clay is found there, refractory enough for seggars in which hard porcelain may be baked. Kaolin is the base of the paste, to which is added a great deal of phosphate of lime obtained from calcined bones, those of sheep being thought the very best; horse and pig bones color the paste. This phosphate of lime is the distinguishing characteristic of the paste of English porcelains, which are classed as **Bone Phosphate Body Porcelains.** At first the composition of the paste was almost identical with that of fine ball-clay earthenware, and flint-glass was added in order to secure translucence. In the place of this glass, Josiah Spode substituted phosphate of lime from bones, the phosphoric acid of this being found to produce with the other materials the necessary translucence. Next kaolin was substituted for ball-clay, and feldspar was added. Borax, soda, and even oxide of tin, are sometimes added to the paste, which is much more fusible than that of hard porcelain. The paste being moderately plastic can be thrown or moulded.

The porcelain biscuit (clay feldspar body) called parian, which is so much used for statuettes, is slightly different in composition from the above. It has an agreeable warm yellowish tint, and is sufficiently glazed by the action of the fire. It must, however, be cast, the paste not being plastic enough to be modelled by hand. Some of the Wedgwood colored wares were in reality porcelain biscuits; it is often hard to distinguish them from fine stoneware. A *boracic glaze*, harder than that of Sèvres soft porcelain, is generally used now. It is not easily scratched, is not affected by acids, and gives great brilliancy to the colors used. It is usually put on by a dip.

English porcelain is of a soft creamy white color, very agreeable to the eye, and is a good ware for table use. It seems to take a place between hard porcelain and fritted porcelain, while it is much easier to make than this latter, and consequently is cheaper. Nearly all the regular kiln colors can be used on it, and owing to the fusibility of the glaze, which softens at a moderate red heat, the colors sink a little into it, and so acquire a glossiness and brilliancy approaching that of the old Sèvres. For the same reason the list of gloss-oven and underglaze colors is large, and much decoration is either painted or printed under the glaze; this last, like all other mechanical work in England, being perfectly well done. As a rule, the decorations on ordinary table ware are rather crude in color and common-place in design.

Of late years there has been a wonderful change in the artistic character of expensive English porcelain. Most beautiful wares of all kinds are made, some showing great originality, but the most of them being but literal copies or close imitations of Eastern and particularly of Japanese ware. These wares show remarkable skill in potting and manipulation of all kinds. The paste being plastic can be used in almost any way. Some delicate Worcester porcelains at the French exhibition, 1878, had open-work spaces filled in with colored enamels, while other wares had patterns etched on the glaze by means of hydrofluoric acid; others again had black grounds with transparent figures on them. The most celebrated English firms, with characteristic English good sense, employ distinguished foreign as well as native artists, and are continually inventing new and beautiful effects, the slip-painting on English porcelain called pâte-sur-pâte being now almost a specialty of M. Solon Milés. The decorations here considered especially English in style, and which are fashionable at present, are apt to have either a sort of conventionality run wild, or else a disagreeable odd stiffness of drawing and crudity of color, these being the prevailing faults indeed of English art work of all kinds. The old English soft porcelains, many of which are much prized by collectors, were very like the artificial soft, and were made principally at Bow, Chelsea, Derby, and Worcester.

The most famous modern potteries are the Royal Worcester, Minton, the Coalbrookdale works, Copeland, and Brownfield. Wares similar in composition to the English are now made at Creil and Bordeaux, in France, and elsewhere. According to Prime (page 402), China works were established in Philadelphia before 1770, and judging from the advertisement for shank-bones in an old paper, and the fact that the porcelain is promised to be like that made at Bow, this porcelain must have been like English bone porcelain.

PART IV.

FOR THE DECORATOR.

CHAPTER XVI.

KERAMIC PAINTING.

Practical Hints.—In order to make *good* paintings on any kind of pottery a knowledge of drawing and painting in general is absolutely necessary. In order to do the best work the decorator should have a thorough artistic training. Almost all the difficulties experienced by would-be decorators are owing to the fact that they attempt work for which they have not had the slightest preparation. Before attempting any keramic painting a person should be able to make a correct and accurate copy on paper of a drawing or painting. If it can be done in color, so much the better. Without at least this slight degree of preliminary training it is useless to expect to do any good work.

Good effects of a very simple kind may possibly be produced by persons ignorant of drawing, if they will be satisfied with simple effects, but the trouble almost invariably is that persons who cannot draw at all wish to do the most difficult work. Unfortunately, too, such people, after doing abominable work, have not the knowledge of its badness, and so are satisfied with the abomination. The characteristic of most work done in this country is crudeness, and utter absence of finish, caused by want of proper training. Many persons think that by means of tracing they can obviate this difficulty. Tracing is of use only as a guide, and even in the simplest patterns the hand requires training in order to make good and pleasing lines. It is rather curious that persons who would acknowledge themselves incapable of making a good water-color drawing will, without any hesitation, attempt the most difficult work on porcelain.

Painting on Hard Porcelain (Over-glaze).—This is done with the regular kiln or muffle colors. Read over carefully what is said about them Chap. VIII., page 72. Never attempt to decorate ware that has been used. Choose the best quality of French ware. That marked $\frac{\text{H \& C}^{o}}{\text{L}}$ is always excellent; it is made by Haviland and Co., at Limoges. See that the pieces are regular and even in shape, and free from spots or places where the glaze seems rubbed off. Hold each piece so that the light ccmes across the surface, and if the glaze seems full of little depressions like an egg-shell, reject it. This defect is generally caused by the excessive thinness of the glaze. Turn it over and see if there is a depressed mark across the name; if so it is a defective piece, rejected by the factory for decoration. Nearly all the plates sent to this country are thus marked. In many cases, however, they can be used. Most shop-keepers know nothing about these matters from the decorator's point of view, and some do not even know the difference between fine faïence or earthenware and porcelain. So the *purchaser* must know exactly what he wants. English porcelain has many excellent qualities, but the French is best for first attempts. For ordinary work the student requires: A large bottle spirits of turpentine; a large bottle ninety-eight per cent. alchohol; small bottle oil of cloves; small bottle oil of lavender; *these last two must be the essential oils, with no alcohol* in them, or else the work will be ruined; one small bottle oil of turpentine or fat oil. (When **Oil** alone is spoken of in books that is what is meant, *not linseed oil.* Fat oil is made by exposing turpentine to the sun and air without allowing any dust to get into it. It is very thick and sticky). The student also requires a cake or pan of *water-color* carmine, a good many camel-hair brushes of different sizes, flat and round, such as are used for water-colors, will do, either in quills, or mounted in german silver. The handles should be at least as long as an ordinary pencil; it is impossible to do good work with short brushes. Besides these there should be several *putois*, or dabbers, a thick round brush, which seems to have the top cut off either straight or slanting, sometimes called a blender. These brushes should vary in size from about a ten-cent piece to very small ones. The straight top ones should be chosen; they are expensive brushes, and are apt to be very unsatisfactory;

a good one is a treasure. One or two *tracers* or *liners*, brushes with very long fine hairs, are useful. One or two hard lead pencils, and some lithographic crayons. A horn or ivory palette-knife and one of steel, both as flexible as possible. A needle set in a handle. A china-painter's palette, which is a porcelain slab full of holes for the colors, and which should have a cover. A small glass muller for using with powder colors. This should be chosen with great care, and should be of a very hard glass, as a muller made of a soft lead glass may injure them perceptibly. Two or three slabs or pieces of ground glass; generally called *glass palettes* in the books. For very fine work a large slab should be obtained, bedded in plaster so as to be perfectly flat and even. The under surface of the muller should also be perfectly flat, so that the two surfaces are completely in contact. Tracing and impression paper, a little modelling wax, plenty of fine linen rags, some if possible of very fine old linen, such as is used for the finest handkerchiefs. It is well to have a table arranged expressly for this work. Such a table should have one or more small drawers for brushes, colors, etc., and one large one for designs, plaques, etc. There should also be a piece of wood about two feet or less long, and about six inches wide, arranged so that it can be put at right angles to the table; this can either be done by means of a screw and nut fastening to the top of the table, or it can be arranged so as to slip in a groove under the top, like a drawer. Many persons work without this rest or support, but it is a great advantage in many cases. The whole table should have a high edge or border except in the front; it is convenient to have this higher than the little bottles used. This edge supports a cover which must always be put over the table when not in use. Such a table is very convenient; nevertheless, the ingenious student can supply its place by pasteboard boxes and other contrivances.

A rest for the hand is necessary, which can either be a flat ruler supported on two small blocks, or a strip of wood about an inch and a half wide, and as long as is needed, supported on feet at each end. Large plaques can be painted on an easel. In all cases great care must be taken to cover the work so as to keep out the dust or fluff, which is the great enemy of the keramic painter. There are many excellent color makers; but the most convenient paints for beginners are those prepared with turpentine, etc., and put up in tubes ready for use by A. Lacroix, of Paris.* In buying these the student is certain of obtaining good colors. All the colors in the following list, and many more, can be obtained in powder or in the Lacroix tube colors, though some of them are a little difficult to find in this country. A list of the principal colors used is here given, with rough indications of their ingredients, so as to prevent improper mixtures. These indications apply to all fluxed colors. The convenient classification in-

* See note 13, Appendix B.

vented by Lacroix is followed. This classes them in regard to their containing more or less or no *iron.* The student will do well to learn the heads of this classification by heart. These Lacroix colors and the other articles mentioned can be obtained at any good store for artists' materials. The colors marked with a star are enough for a beginner. Until otherwise mentioned, the Lacroix tube colors are meant. These paints are manufactured for use on the *glaze* of porcelain and of fine earthenwares (*faïences fines*) *only.* Their use on other wares, though occasionally successful, is, nevertheless, attended with great risks, and the baker cannot be blamed for failure. Never use over glaze the Lacroix colors marked **G. F.** (*grand feu*) in one corner of the label, as they are underglaze colors.

In ordering the Lacroix colors always give the French name in full, as the English name differs with different dealers. Be careful to mention all the letters or numbers. Those under the column marked Sèvres should always be put in brackets in sending to Paris for colors; but it is not necessary to do so in sending to dealers here, except where the Sèvres number is repeated in the first column, as for example, "Jaune M. à mêler, 41 de Sèvres—Lacroix color in tubes."

Should powder color be desired, state that fact. If the grounding colors are wanted, state distinctly that the "couleurs pour fonds, or grounding colors" are wanted. Mention also that the colors are to be the ones used on porcelain. See that the tubes have Lacroix's name on them, as other colors are put up in tubes. Most of these are inferior, and at any rate colors by different makers should not be used together. So many disappointments arise from carelessness in these small matters, that the above precautions cannot be too strongly urged.

Most of the colors used in porcelain painting change very little in firing, only becoming glossy instead of dull; except, indeed, in the case of injudicious mixtures. Carmines change very much, being a very dull muddy color when applied, changing to bright pink when properly baked. Owing to the danger of thick colors scaling off, it is better to shade by a succession of tints,increasing in darkness, than by putting on any one color or mixture of colors thick and thin. All these remarks apply both to powder and to tube colors. If the sample plates mentioned further on have been carefully made and studied, the student will have but little trouble. It is impossible to be quite certain of effect without careful trials. Tube colors should be kept in a cool place, and the tops screwed on tight; it is also well frequently to change their position so that the paint may not settle.

Should the paints get dry in the tubes, these can be opened at the bottom, the paint taken out, and before using it can be ground on the slab with the muller with a little turpentine.

GROUP I.—Colors without Iron which are Whites, Uranium-Yellow, Platina-

French Names.	De Sèvres.	English Names.	Colors.
Blanc Chinois....... ...	4	Chinese white	....
Blanc fixe..............	2	Permanent white...	....
*Bleu ciel azur		Sky blue...........	....
*Bleu ciel clair ou tendre	28T	Light sky blue	Very pale blue.....
Bleu foncé.............	24	Dark blue..........	....
*Bleu outremer riche ...		Deep ultramarine..	Bright, but not very dark...........
*Bleu Victoria ou ordinaire.......		Victoria or ordinary or common blue..	Very deep rich blue
Bleu vert...............		Blue green.......	Greenish blues....
Bleu turquoise..........	23	Turquoise........	
*Bleu riche.............		Deep blue..........	Dark and deep in tone and something like indigo ....
*Carmin tendre A.......		Light carmine A...	Very light pink....
Carmin tendre No. 1....		" " No. 1..	Pale rosy pink.....
Carmin No. 2...........		Carmine No. 2.....	Pink, a little blueish
*Carmin No. 3 foncé....		Deep carmine No. 3..	Rich pink.........
*Laque carminée.......		Crimson lake.......	....
Pourpre cramoisi		Crimson purple.....	....
*Pourpre riche.........		Deep purple.......	More like deep rose color............
Pourpre rubis...........		Ruby purple........	Superb dark claret.
Pourpre No. 2..........	60	Purple No. 2........	Rather light, more like solferino or crimson ... .
Pourpre ordinaire.......	60	Purple.............	Darker............
*Violet d'or clair.		Light violet of gold,	Rich purples ....
*Violet d'or foncé.......		Deep " " "	
Jaune d'urane..........		Uranium yellow....	Dark yellow.........
Gris de platine..........	9	Platina grey........	Soft neutral grey....
Noir d'iridium..........		Iridium black......	....

Blues, Gold Colors (that is the Colors made with Gold), Grey and Iridium-Black.

Ingredients.	Remarks.
Tin, arsenic, phosphate of lime	White is very little used in porcelain painting, as it is apt to crack off.
Cobalt modified by zinc Cobalt modified by zinc alumina, arsenic, etc Principally cobalt	Blues can be shaded or mixed with each other or with purples and jonquil, and mixing yellows. With carmines they make fine violets. Great care must be taken in mixing them with ochres or brown, as they do not work well with the iron colors; nevertheless, fine flesh tones can often be obtained from green-blue and other blues and purplish red mixed, also from the violets of iron and blues. Blue and capucine make a warm black. Blues should be put on thinly, as they are apt to scale off.
Purple of Cassius with a little chloride of silver and more or less flux to lighten or darken the colors Purples are the same as carmines, modified by oxide of gold and different fluxes	All gold colors, which are the carmines, purples, gold violets and laque carminée must be used thin and with but little fat turpentine. They mix well with yellows, greens, blues and browns. *Never* use carmines for flesh on hard porcelain. The carmines can be put over yellow in a second baking, and then give a color like vermillion. The English carmines are the best, but must be tested before using. They do not come in tubes. If carmines are fired at too low a temperature, they are yellowish, if at too high they have a lilac tinge. If applied too thickly they are apt to be yellowish also.
Purple of Cassius—very little silver	These must be used carefully on fine earthenware, as they are often spoiled by the glaze—should be tested for delicate work. Mix well with blues, yellows and greens.
Uranium	Does not mix well.
Platina—metal	An excellent grey that can be mixed with any color and will not injure it as do the iron greys (group 3). Very expensive.
Ox. iridium	Excellent black that can be mixed with all colors without injury. Very expensive.

GROUP II.—COLORS WITH LITTLE

FRENCH NAMES.	De Sèvres.	ENGLISH NAMES.	COLORS.
Jaune pale fixe		Permanent yellow..	....
*Jaune M. à meler 41 de sèvres	41	Mixing yellow......	Bright, cool yellow..
Jaune 43 C.............	43	....	Darker yellow ......
Jaune 46................	46	....	Still darker..........
*Jaune d'ivoire 47 de sèvres	47	Ivory yellow.......	A very bright yellow, not in the least like ivory ....
*Jaune d'argent........		Silver yellow.......	Very bright and warm
*Jaune orangé..........		Orange yellow.....	Not very deep in tone
*Jaune jonquille........		Jonquil yellow.....	Bright canary yellow
Jaune d'urane		Uranium yellow....	See group 1..........
		Greens.	
*Vert No. 5 pré.........	35	Grass green........	Dull, soft, rich yellow green........
*Vert No. 6, brun ou olive	39	Brown green.......	
*Vert No. 7, noir........		Dark green........	Very cold and dark more like greenish grey........
Vert 36, T.......	36	Green No. 36, T....	Like grass green, only darker......
Vert 36, D.............	36	Green No. 36, D....	Like 36 T., only darker...........
Vert bleu, riche.........		Deep blue green....	
*Vert chrome 3, B.......		Chrome green 3, B.	Rich blue green....
Vert chrome, riche......		Deep Chrome green	A rich blue green..
*Vert bleuâtre'..........	34	Bluish green.......	....
Vert émeraude.........		Emerald stone green	Deep yellow green
Vert pomme............		Apple green........	Intense crude green
Vert russe.............		Deep green........	Rich dark blue green............
*Vert de vessie..........		Sap green..........	

or no Iron, Yellows and Greens.

Ingredients.	Remarks.
....	Very difficult to use, almost invariably a failure.
Practically no iron.....	Destroys the iron colors, but mixes well with the gold colors, with greys and with blues.
Practically no iron.....	Excellent colors, same as 41 only darker. Particularly fine with gold colors and greens.
Practically no iron.....	
....	This is also called jaune pâle pour les chairs, a much better name than jaune d'ivoire. It is the opposite of No. 41. It mixes with the iron colors, but is not good for the gold colors.
A mixture of jaune jonquille and jaune orangé—no silver at all in it	Mixes well with blues and gold colors.
All yellows are made of potash, zinc, iron, and occasionally a little uranium	Yellows intensify in baking, so must be used carefully. When used in centre of flowers always place the yellow directly on the porcelain. Mixing yellow and jonquil yellow have practically no iron in them, and are to be used with blues for fresh bright greens.
Chrome, cobalt, zinc, sometimes iron, particularly for the darker greens—sometimes alumina..............	Greens all work well, but are apt to become too bright or crude when fired. They can be modified by carmines or purples or by grey No. 1. Bright tints must not be placed over dark ones or they will be destroyed in the firing. Greens can also be modified with yellows, blues and the iron colors.
....	Deep blue green can be used instead of this if it cannot be obtained.

GROUP III.—In which Iron is either the Base or the Coloring
As a rule these Colors must not

French Names.	De Sèvres	English Names.	Colors.
*Rouge chair 1.........	62	Flesh red or carnation 1............	Cool greyish red....
*Rouge chair 2.........	62	Flesh red or carnation 2............	Very like light red in oils....... ....
Rouge chair 3..........	62	Flesh red or carnation 3....	Very like light red in oils, darker........
*Rouge carminé........	63	Carmine red........	....
*Rouge laqueux	64	Laky red...........	Rich red maroon ...
Rouge violâtre pale.....	66	Purplish red........	....
*Violet de fer foncé.....	66	Dark violet of iron.	More a rich purplish brown than violet
*Violet de fer teinte grise	66	Gray violet of iron.	
*Brun Rouge...........	67	Red brown.........	More red than brown
Rouge Sanguin.........	55	Blood red..........	
Rouge orangé...........	58	Orange red.........	Deep orange.......
*Rouge capucine......		Capucine red.......	Brilliant, rather bricky red.......
*Brun, 3 bitume.........		Brown No. 3.......	Bright yellowish brown ....
*Brun 4, foncé, 17.......		Brown No. 4 or 17..	Rich dark neutral brown ....
Brun mordoré..........	69	Golden brown......	Reddish brown.....
Brun clair..............		Light brown.......	
Brun foncé.............		Dark brown........	
*Brun de bois...........	70	Wood brown.......	....
Brun M. ou 108.........		Brown M. or 108...	Very yellow brown..
*Brun sépia.............		Sepia	Very like raw sienna.
*Brun jaune....	49	Yellow brown......	Dark salmou color..
*Ocre à vert A. V.......	50	Ochre for greens...	....
*Ocre...................	50	Ochre	....
Ocre foncé..............	50	Dark ochre........	Much the same as brun jaune.
*Gris No. 1.............		Grey No. 1	Bluish grey ....
*Gris No. 2.............		Grey No. 2	Warmer grey.........
*Gris noir ou foncé.....	12	Neutral grey.......	....
Gris roux ou roussâtre..	13	Warm grey	Like light flesh color
Gris rosâtre	13°	Rosy grey	Same as rouge chair No. 1.

MATTER: REDS, RED-BROWNS, BROWNS, OCHRES, GREYS, BLACKS.
BE MIXED WITH THOSE OF GROUP I.

INGREDIENTS.	REMARKS.
All the iron reds are made from the red oxide of iron varied by the method of preparation, not by mixtures of other colors.	Very valuable colors alone or with yellow No. 47. Do not mix well with blacks, greys or blues. They disappear entirely when glazed with yellow, but yellows can be glazed by them. None of the lighter reds will stand much heat.
....	Must not be confounded with laque carminée (a gold color). Can be made from rouge laqueux and a little yellow 47 (ivory yellow).
....	This is a hard color and does not glaze well. Is improved by a little ivory yellow.
....	Good in flesh (see blues). When mixed with blues these colors dull them a little. Mixed with yellow ochre, give beautiful warm browns. Rouge violâtre pale is sometimes called light violet of iron.
....	Excellent color, sometimes does not glaze well, then mix with a little ivory yellow.
....	With blue make blacks.
Browns and ochres are made from brown oxide of iron, modified by cobalt and zinc.	All good, intensify in firing, so dark touches or tints should be reserved for the second baking. As a rule do not mix well with colors of group 1.
....	Excellent for retouching, also for shading blues in conjunction with certain greys, carmines and yellows.
....	~~Excellent color~~, can be mixed with all colors.
....	Mixes well with reds.
....	To mix with greens, purples and carmines.
....	Mixes with ivory yellows and the flesh reds for dark flesh tints, does not mix well with green, but is good to glaze green. Ochres and iron reds mix well.
Greys are made of iron, cobalt and zinc in different proportions.	Apt to injure reds.
....	An excellent color, mixes with all others; darkens very much in firing.
....	Very fusible; good in flesh tints; also for glazing—must be used thin.

GROUP III.—In which Iron is either the Base or the Coloring
As a rule these Colors must not be

French Names.	De Sèvres	English Names.	Colors.
*Gris 6 ou perle	14	Pearl gray	Light yellowish gray
Gris Bleuâtre...........	15	Blue gray..........	....
Gris de Platine.........		Platina gray	See group 1 ....
Noir corbeau		Raven black	....
Noir d' ivoire..........		Ivory black	....
Noir foncé..............	19	....	....
Noir d' iridium	20	Iridium black	....

MATTER: REDS, RED-BROWNS, BROWNS, OCHRES, GREYS, BLACKS. MIXED WITH THOSE OF GROUP I.—*Continued.*

INGREDIENTS.	REMARKS.
....	Very fusible; dangerous with the iron colors, sometimes causing them to disappear when baked. These fusible greys when mixed in too large quantities with other colors are apt to make spots that look oily after firing. They are also apt to spoil or dull delicate tints of any kind, particularly the flesh-colors. They must be used with great caution.
½ gris noir (12) ½ blue tendre (28 T.)	A very useful color, but apt to injure reds. All of these greys have cobalt and iron in them which mixture tends to produce black. Delicate greys, without iron, can be made by mixing greens with carmines and purples, or yellows with gold violets; such greys can be used with impunity with colors of group No. 1, but no rules can be given for making them. Platina grey, group 1, is perfectly safe with all colors.
Cobalt and iron.	Blacks must be used very carefully, as when used thick they are apt to crack off. When used thin, they should have a little blue added.
See group 1	Very good blacks are obtained by using deep red and deep blue, one over the other; when thus used, it is better to have a separate baking for each color. See also rouge capucine. It is always a risk to mix these blacks with other colors. Iridium black is safe. See group 1.
	There is no color resembling vermillion, except coral, and this is very dangerous to use and cannot be mixed. Capucine red, and a little flesh red mixed and put on thin, give a tint like French vermillion.
	The above remarks apply to all porcelain, or rather regular kiln colors (couleurs de mouffle tendres); English, French or German, in tubes or in powder. The colors marked with a star are all and more than are necessary for a beginner.

LIST OF GROUNDING OR BAGKGROUND COLORS.

These colors and, above all, those marked P F, must not be mixed either with each other or with those in the first list.

French Names.	English Names.	Remarks.
Bleu céleste..........	Celestial blue.......	A strong rich blue.
Bleu Indien..........	Indian blue	Much the same only deeper.
Bleu lavande.........	Lavender blue......	What we should call lavender, not blue at all.
Bleu marin...........	Marine blue........	Much the same as bleu celeste only greener.
Brun mordoré........	Reddish brown.....	Also comes for painting.
Café au lait..........	Light coffee color...	Color of coffee with milk in it.
Carmélite............	Carmelite	A rich deep red or maroon.
Céladon..............	Celadon............	A peculiar greenish or bluish gray, very delicate.
Corail	Coral red...........	
Gris d'acier..........	Steel gray.........	
Gris tourterelle.......	Turtle dove gray...	More like a brown gray or drab, very soft and pretty.
Isabelle..............	Isabelle............	A sort of fawn color.
Jaune Chinois.	Chinese yellow.....	A very bright clear yellow.
Lilas fusible..........	Fusible lilac........	
Maïs.................	Maize..............	Corn color.
Mauve...............	Mauve.	
Rose Pompadour.....	Rose Pompadour...	A bright soft pink.
Saumon..............	Salmon.............	
Turquoise bleu.......	Turquoise blue.....	A very rich rather light blue; also comes for painting.
Turquoise vert.......	Turquoise green....	A very rich greenish blue; also comes for painting.
Vert pour fonds	Grounding green ...	A very brilliant rather crude green.
Vert d'eau au cuivre.	Copper water green.	A very delicate beautiful bluish green, very light in tone.
Vert d'eau au chrome.	Chrome water green	Much the same as the above, only greener and darker.

English and German colors have about the same power as pigments as the French, but the names given them vary somewhat. (See powder colors.) No colors made in this country have as yet been worth much.

The first thing is thoroughly to understand the colors and the effect they produce after they are fired. For this purpose take two plates, or else broken pieces, of the same kind of ware as that to be decorated. If a plate, draw lines running from the circumference to the centre, so dividing the edge of the plate into as many compartments as there are colors to be used. Squeeze out a little of each color on the glass slab, and rub it down well with the palette-knife, using a horn or ivory knife for the first and second group of colors. If the color is too thick, add turpentine; if it dries too quickly, add a drop or two of lavender, which also often makes the colors more easy to manage. Either use the colors directly from the slab, or lift them into the holes in the porcelain palette, where, if well covered, they will keep a day or two. Then fill each compartment of the plate with a color, putting it on very thick at the one end, and letting it grow thinner at the other, until it fades into the white of the porcelain. Some colors will be easy to manage, others very difficult. Mistakes can be wiped out with either a dry rag, or one moistened with a little turpentine. Persevere till all are as well graded as possible on both plates or slabs. After the paint is perfectly dry, which will probably require at least twenty-four hours, and which can be known by its looking dull, put all around the plate, going over each color, a band of carmine, one of purple, one of pearl grey, and one of dark grey. These bands must be very narrow so as not entirely to cover the colors under them. The middle of the plate should be left clean, for experiments in obtaining greys by various mixtures, such as greens and carmines, greens and purple or gold violets, iron violets with green and blue, etc. All such mixtures should be carefully noted down. When all is finished and quite dry, one plate is baked and the other is kept, and so the difference between the baked and the unbaked colors can be learned better than in any other way. For careful or elaborate work of any kind tests of this nature should always be made; there is no other way of thoroughly learning the qualities or values of the colors. When baked, the carmine (on porcelain) should be of a bright rose color. If not sufficiently baked, it is brick red; if too much baked, it has a violet tinge. It is best to make the first attempt at painting with a single color. Take broken plates, or any flat bits of porcelain, or even earthenware tiles, and trace circles with water-color carmine, then try to fill up these circles with color, endeavoring to make it as flat and even as possible. Try not to go beyond the outline of the circle; if this is done by mistake, the color should be scratched off when dry. It will soon be discovered that some colors are much harder to manage than others, particularly blues, purple, carmines, and greys. It is sometimes necessary to add a little fat turpentine to these colors, but this must be done cautiously, as too much will make the paint crack and boil up, as it is called, when baked. The best way is just to take up a little on the tip of the brush. Turpentine can be used freely, very much as water is used in water-color, still it is not well to have the paints too wet. Should the paint dry too quickly, a very little oil of lavender will correct this fault. After trying to lay these tints as flat as possible with an ordinary paint brush, they can be wiped out and a new set can be done with the **Putois.** It is almost impossible to describe the use of this brush in words, while, if the process be once seen, it is perfectly easy to understand. Add a little fat turpentine and lavender to the color, and grind in well with the muller or knife. Take a flat brush and go all over the surface that is to be colored, no matter if the tint be rather uneven, and the brush-marks visible. Let the color alone a little while, and when it feels sticky, go all over it with the putois, holding it perpendicular to the plate, and striking short rapid strokes, turning the brush in the fingers. If well done a perfectly even surface will be produced. The brush should never strike twice in succession the same place. Should the brush take up any color, it must be laid aside, and a new one taken up. In all cases the brush must be dry, clean, and free from dust. The student must not be discouraged if it takes him some time to learn to lay a good flat tint. This is the method generally used for laying flat grounds of all colors. It will soon be found that dark grounds are much harder to manage than light ones. It is much better to learn this process from a teacher, or from seeing it done by a decorator. There is another method with powder colors much used for grounds or flat tints, which will be described in its place. As soon as the student can make good flat tints, he should try imitating an object in relief, such as a ball or an egg. For the former, circles can be traced as before, and the ball should be shaded with great care, still using only one color for each ball, different methods being tried in order to have facility in working. It may all be done by the putois; this will be found difficult, but the knowledge and the freedom of hand obtained by repeated attempts will be found very useful. Other balls should be shaded by hatching (crossed lines such as are seen in copper-plate engravings), and stippling (dotting or filling up small spaces by dots), or by combining both methods. When the student can make a good ball in all of these methods, he will have acquired a great deal of control over his tools.

It will be well next to practice grading one color into another, say blue into yellow. Take light blue, and making it dark at the top of the plate or tile, grade it until it is lost in the white of the porcelain; then try the same process with the yellow, only reversing it, so that the light parts of both colors come together. This method is often used for graded skies, but in actual practice it is best to have the first color baked before the next is put on, as otherwise the work is apt to be spoiled in the baking. It is hardly worth while to have the above studies baked. They can be wiped off, and the porcelain used for finer work intended to be kept. When persons are not willing to go through so thorough a preliminary training, perhaps the best things to take are conventional patterns in solid colors with good clear outlines. Good subjects of this class, with directions for coloring, can be found in Piton's first album for painting on China. Such work can be done on the white *Minton* tiles sold for decorating. The colored tiles should be avoided by beginners.

The next step had better be a **Monochrome** (Fr. *camaïeu*), that is, a subject painted all in one color, say a group of figures. There are pretty lithographs sold, that are very suitable for this purpose; but anything will do, especially as the first attempts should be regarded only as studies. It may be remarked that, even for persons never expecting to paint figures on pottery, it is well to do them for practice, because they are the most difficult things to do well. There are different methods of putting the design on the plate. It can be drawn at once, using for this purpose lithographic crayon, which marks perfectly well on the unprepared porcelain, or else a lead pencil can be used; for this last the plate must be prepared by wiping it over with turpentine or with alcohol. The design is generally put on by **Tracing** it, which is the best way, as then everything can at once be put in the right place. The tracing is made and is then fastened to the plate by means of small pieces of modelling wax or of gummed paper. The impression paper is slipped underneath, and the design gone over with a point, or a hard lead pencil; on lifting off the paper the design will be faintly marked in red lines. The outline should then be carefully gone over and corrected in water-color carmine, which will disappear in the firing. The lines must be made as delicate as possible, and the fewer the better. The tracing paper lines, and the marks left by the wax should always be wiped with a fine rag, as otherwise these marks often affect delicate colors. The design could be drawn in at once with the carmine if desired. Deep red brown is a very easy color to manage, and looks well when burnt; still, if the student has faithfully worked at his balls and eggs, he can use any color with facility. The carmine outline being in water-color, is not affected by the turpentine color; thus making it very convenient to put in a background with the putois. In this case, after the back-ground is dry, the carmine outline can be distinctly seen through it, and the color can be scraped off the pattern with a knife, leaving the white porcelain. Another way is to take a very little clove oil and go carefully all round the outline with a fine brush. Then with a fine rag wipe away the oil, which will bring the color with it, leaving the design clearly outlined. Be sure the paint is perfectly dry before doing this; it is better to wait a day. Still another way is to paint all over the parts of the pattern covered by the ground with oil-color lake mixed with a little lavender, and in about a quarter of an hour the whole can be wiped off. This should be first tried on something of no importance. When easily managed it is very quick work. Beginners generally spoil their first attempts.

Color Studies.—If the monochrome is successful, a study in a variety of colors can next be tried. For any elaborate work it is absolutely necessary to make double samples of the mixtures of tints desired and have them fired. There is no other method of finding out how they will look. For ordinary work this is hardly necessary. A little practice soon teaches what to expect. Before beginning the study, read over carefully the column of remarks in the table of colors, paying particular attention to what is said about the colors to be used in the study.

White should not be used by beginners, the white of the porcelain taking its place. The method of putting on the outline is the same as that just described for monochrome. Certain colors, of which there is a large variety, are sold especially for backgrounds. They must not be mixed with the other colors (see list). Any color, however, can be used for backgrounds; some working much better than others. Flowers are perhaps the best subjects to begin with in colors, as the tints are generally pure. If a good painting on porcelain can be procured to work from, so much the better.

Every good decorator is apt to have a color-method of his own. All methods which succeed are good, and a skillful painter will get fine effects from mixtures of colors utterly forbidden in books. The student must remember that *colors* are affected by **Juxtaposition**, as well as by their actual tint. In copying make as *exact* a copy as possible. Let there be no slurred nor imperfect work. Wipe it all out a dozen times, if necessary. Nothing can take the place of careful practice, and the knowledge gained by patient endeavor is very valuable. The only way to obtain freedom and breadth in after work is by elaborate painstaking at first. Even good artists are bewildered and annoyed by the tricks played by the ungrateful medium. A second wash of color should not be put on until the first is perfectly dry, or it will come off. When necessary, tints can be blended with a small putois; but it is better to do without it if possible and get the effect by means of the ordinary brush. Do not tease or torment the colors. Try to get the right color in the right place and then leave it alone.

The following hints may be useful:

Colored Flowers.—

BLACKBERRIES.—Purple put on thin, when dry glaze lights with sky-blue, shadows with sap green (*vert de vessie*) or brown green.

BUTTERCUPS.—Orange yellow, thin for the lights, ochre in the shades.

CAMPANULAS.—Lights sky-blue, purple and blue in shadows.

CORN-POPPIES, RED.—Two firings: first firing, lights orange-red, shadows lakey red, heart iridium black; second firing, touch up the shadows with carmine No. 3.

PERIWINKLES.—Lights sky-blue, shades ultramarine with a touch of purple, centre silver yellow, touched up with carmine red (*rouge-carminé*).

ROSES, PINK.—Carmine No. 1, thin in high lights. Carmine No. 3 for shadows, and the same thicker for the heart of the flower. When *perfectly dry*, glaze with sky-blue where needed in the light, and with green in the shadows. (To glaze is to put a thin wash of color.)

ROSES, RED, require two firings to be well done, so should not be tried without a good firer. First fire, carmine red (lakey red will do with a touch of ivory yellow). After this firing use carmine No. 3 to finish with. Glaze shadows with ultramarine. Do not confound *rouge carminé* (iron) with *laque carminée* (gold), they belong to differen groups.

ROSES, YELLOW.—Silver yellow in the light, yellow ochre in shadows. Deepest shades in orange yellow.

VIOLETS.—Sky-blue mixed with gold violet, shadows pure gold violet.

White Flowers should have a dark background of leaves, etc. White of the porcelain shaded with blueish, greenish or pinkish greys, which are made from light greys by adding blue, ochre, or purple. Sometimes these four colors, or the three last alone, mixed in different proportions, will give beautiful tones of grey. It is better to use no white paint. In putting yellow in the centres of flowers, always clean off any color, so that the yellow will rest directly on the white porcelain.

Foliage.—Use greenish blues for high lights, chrome green thin for the shades, chrome and ochre for deep shadows. For yellowish greens in high light, silver yellow mixed with chrome; shadows sap green. Dark greens, silver yellow and chrome mixed with brown, or even with dark green No. 7. For young shoots, carmine and silver yellow. For distant flowers, same tints as near, only much thinner. For distant leaves, silver yellow, chrome green, purple, and light grey, mixed in different proportions, as the tints desired are more yellow, more pink, or more grey.

Landscape—Skies.—Sky-blue put on with putois. The clouds can be gently wiped out with a fine rag, and the shadows put on with delicate greys like those for flowers. Another way: sky-blue, violet of iron, ivory yellow, put on side by side in decided flat touches. Then blend with putois.

Distances.—Purple, chrome green, silver yellow, black. These four colors are mixed to the desired shades, or else bluish greys can be used with a little carmine. Nearer the foreground, ochres and blue greens can be used.

Foregrounds—Earth, etc.—Greyish and reddish tones must be put on boldly, never using the putois. Strengthen with violet of iron, with browns, greys, greens, according to what is to be represented.

Trees.—*Near:* Bluish-green and carmine.—*Distant*—Yellow greens made of ochre and ultramarine. Most of the greens sold answer for foliage, but they are all crude, and must have purple or carmine mixed with them. The reddish or warm tones are obtained by the various browns, and by iron violet mixed with sky-blue.

Houses, walls, etc.—Ivory-yellow, ochre; shadows bluish grey, touched up with bitumen.

Water.—This takes its tones from its surroundings—sometimes sky-blue where it reflects the sky, sometimes greenish, and brownish.

Ocean.—Greenish-blue—blue with a little mixing-yellow. Brown touches for reflections, etc. Let all the brush strokes be horizontal. Can be retouched after firing. Excellent effects in foregrounds, trees, etc., can be obtained by scraping out lines or spots with a sharpened stick.

After firing the colors are apt to be hard and rather glaring. They can be toned down by glazing shadows and distances with the same mixtures as described for white flowers, and firing a second time. Though the gold colors may not be *mixed* with the iron colors, in many cases they may be put over them in a second baking.

Heads.—The general tint is ivory-yellow and flesh-red No. 1, about one-third red to two-thirds yellow. Before putting this on, the eyes, nostrils, corners of the mouth, etc., can be sketched in with the flesh-red pure, and this may also be used for the shadows. When dry, put a thin wash of the general tint; while still wet, the lips, cheeks, etc., can be strengthened in color with the red. Ochre is used for reflected lights. All are then blended with the putois. Violet of iron and greenish-blue can be used for shadows, with sometimes a little grey. The darker flesh colors can be used to finish with. Blue eyes can be painted with sky-blue, greenish-blue, and grey. Brown eyes, yellow, brown, and sepia. Pupils black, and leave or pick out spot of light. Light hair, ivory yellow, shadows yellow-brown and brown 108, grey and bitumen. Darker complexions are made of the darker tones of the same colors—for example, iron violet and ochre for a man's dark, ruddy complexion. In small heads the needle can be used to pick out any little lumps of color, and to soften the general effects. The painting can be stippled and strengthened, grading the color carefully towards the high lights. Delicate grey tones can be used in the half-tints, but must be managed with great care, as they are apt to injure the reds. Do not use sky-blue for this purpose, but a good grey that has been tested.

Platina grey is perfectly safe, and does not injure the reds at all. It is very expensive. Other combinations answer very well in the hands of skilful artists, but the above are those generally used. Ivory yellow or pale yellow for flesh tints is made expressly for this purpose. Too much yellow will spoil the work. The flesh colors will not bear as high a degree of heat as the colors for flowers (see table, Chap. VIII.), so must be fired carefully.

Firing.—In all cases when a painting is to be fired more than once, make the first painting light and sketchy, as though easy to darken tints, it is impossible to lighten them. In this country two, or at the extreme, three firings, should suffice, as few firers here grade the heat. The first firing should be the hottest. If possible finish for one firing. The more delicate the work the more precautions must be taken. For coarse or bold work many of the above directions are superfluous.

Sometimes after the painting is fired, it looks well, but has no glaze, or is only glazed in spots. This is remedied by putting all over it a thin wash of either pearl grey, warm grey, light carmine A, light sky-blue or ivory yellow; according to the tones of color used in the painting. It must then be fired again. In some cases it will be found that by mixing these colors, which are very fusible, with the colors that do not glaze well, the effect will be improved. Purple, for example, hardly ever glazes well, and a little pearl grey mixed with it will have a good effect, and will not sensibly affect the color. The above colors also answer for toning down. As for white, it is very little used in porcelain painting, the white of the porcelain taking its place. It is only used to heighten the effect in small spots of light. For this purpose *blanc fixe* is employed. It can be mixed with colors for these high lights, but is very dangerous to use, as it almost invariably either scales off or boils up, if the firer is not very skillful. For any important work careful preliminary experiments should be made with it. There is no iron in it. Chinese white can in some cases be mixed with color, and used in painting, but is very difficult to manage. In using white it should be put on for the second firing, as it does not require much heat. Always use the colors of the same maker on the same peice of work. This may not always be necessary; but proof that it is unnecessary is only to be had by careful experiment. Care must be taken not to pile on color too thick, as it may scale off.

After the day's work is over, brushes must be carefully washed in turpentine, and dried; never stroking them against the hairs, but drawing them to a point. Once in a while they must be washed in brown or soft-soap lather, and carefully rinsed. Brushes must not be left with turpentine in them for more than a day or two. When very dirty, alcohol will clean them at once, as also palettes, slabs, etc. Never let the alcohol be near any painting, as a drop may spoil all; as will also moisture from the breath, or drops of water. Dampness of any kind, particularly that from an open window on a rainy day, is bad for keramic painting, and often prevents a good glaze. Putois backgrounds should always be put on in a warm, dry room.

The regular kiln-colors just described are also sold in *powder*, and many decorators prefer them in this form. Except for professional workers, however, the tube colors are much more convenient. The Lacroix colors are also sold in powder, and those called *couleurs surbroyées* No. 3 (extra finely ground colors) can be generally used without any further preparation than mixing with the turpentines. All other powder colors, and also the No. 3 Lacroix, if at all gritty, must be prepared as follows: Take a *perfectly clean* ground glass slab, one bedded in plaster is best; take as much powder as will be required for the work, too much rather than too little; add a few drops of lavender; take the muller and grind carefully, going round and round, trying to bring the color from the sides of the slab towards the centre, always pressing pretty hard. The oil and powder will soon form a shiny liquid about as thick as molasses. A little thin turpentine can be added at times, if necessary, and all should be ground until it is perfectly smooth and shiny; then some fat turpentine, generally a little less than the amount of color, should be added, and ground into the mass. This mixture should be ground until it is a little thicker than the oil paints usually sold, and is used in the same way as the tube colors. It will have to be prepared each time for nice work. Should powder colors when bought be extremely gritty, they must first be ground with water on a glass slab, and then when dry, ground with turpentine as described. In this case a quantity can be ground in water at a time, and put away for use. In grinding different colors, it is absolutely necessary to see that the slab is perfectly clean each time; it is better to have separate slabs for delicate colors. Badly ground colors can never produce good effects in painting, and it requires a good deal of practice to grind well, and to know how much fat turpentine to use. Some decorators do not use lavender, but only the two turpentines; some also simply mix or rub down the powders with a palette-knife instead of a muller. This is dangerous, as with an iron knife the little particles of iron are scratched off by the ground glass, and mix with the colors, and in the case of light yellows, for example, the injury is great. With a horn or ivory knife, enough lime may be scratched off to dull the colors considerably. For merely *lifting* little heaps of color from one place to another, it does not matter what knife is used; though it is safer not to use the iron knife with the non-iron colors. Color for a number of pieces that are to be alike should all be prepared at once, as otherwise the tints are apt to vary. For grounds, more fat turpentine may be used than for painting, particularly in purples, carmines, and blues, as otherwise it is difficult to manage the putois.

Laying Grounds With Powder Colors.—It is very difficult to put on dark grounds with the putois, and the method generally used is as follows: Take *grounding* oil which is generally linseed, or still better nut oil, prepared much as drying oil; that is, boiled with a little litharge. In old times garlic and onion were used boiled in vinegar until a sticky syrup was made (this is good for gold on soft porcelain). Thin, if necessary, with turpentine, and put it all over the surface of the piece, say of a plate, then with a dabber, made of cotton wool tied in a piece of soft raw silk, go all over the surface, tapping it lightly till the oil is evenly spread. Take a large blender, as full of coloring powder as it will hold, and dust it all over the surface; if there is too much powder anywhere, brush it off lightly. It is better to learn this method from a decorator. The backgrounds produced in this way are so perfectly flat and smooth as to be inartistic; besides which the powders are often very unwholesome, and should not be inhaled. This is the method almost universally employed for tea services, etc., decorated in bands, or masses of solid color. The Lacroix powder colors (*surbroyée* No. 3) are excellent for the above purpose.

Besides the powder colors of Lacroix there are those of Dubois-Mortelèque (very good for blues and Brun Mordoré), Guyonnet, Colleville (some of his blues are very fine), Pinard, Bunel, Chapelle, Chalmel, and others in France. All French colors, and also all materials needed by the keramic painter, can be obtained in Paris at the sign of the "Bon Broyeur," Carré St. Martin. The English powder colors, when by good makers, are excellent, particularly the carmines. The yellows sometimes have silver in them, and must be used carefully in mixing. Emery's are the English colors most used here. Stevenson is noted for greens. Colclough, Massey's successor, is also well known, as are Harrison, and others. Many German colors are also very good. Those of C. Seidel & Son, Dresden, are recommended by G. W. Nichols. Other well-known German color makers, are Schuhardt, Bidtel, and Geitner & Sons.

The German coral red is the finest made. Unfortunately German colors are nearly always badly ground, and when used for any fine work should be ground over again with the greatest care. The German regular kiln colors are also *harder* than the French and English, and in some respects are more like the hard kiln colors of those countries. Owing to this want of fusibility they must be used very cautiously on soft glazed wares. The firer, too, should be told that they require a good deal of heat, or else the baking may be imperfect. Never mix colors by different makers without experimenting carefully beforehand. It is better to use *French colors* on *French ware*, *English* on *English*, and so on.

nevertheless, the Lacroix and other French colors work very well on English bone *porcelain*, giving soft and beautiful effects. All hard porcelain colors can be generally used on fine earthenware, the only case in which they would not answer would be if the glaze were too fusible, and had too much lead in it. In using German colors, owing to their hardness, very great care would be necessary. All of the regular kiln colors will entirely disappear in too high a temperature. There are colors made and prepared in this country, but so far nothing is to be said of them.

The best **Gilding** is done on the glaze of porcelain before any colors are put on, and is baked at a temperature from 900° to 1000° Cent. (1652° to 1832° F.), which would destroy or injure most colors; besides which the emanations from the gold are apt to prevent the colors from glazing well. The gold is dull when baked, and has to be polished with burnishers, the proper use of which must be learned from a teacher. Burnishing is generally done by women, and requires a good deal of practice. A band of gold is first polished, and the strokes of the burnisher must always be in the same direction; a little vinegar and whiting, or Paris-white, is rubbed over the work, and then it is polished a second time. Various beautiful effects are produced by leaving part of the gold dull and part bright. For ordinary work gold can be obtained from the decorators, and if moist can be used with the addition of a little turpentine.

If in powder it is rubbed down with fat and thin turpentine and then used. A little practice is required to know the right degree of thickness. When mixed with the medium, gold looks brown, or even black. Gold and colors must not be laid over one another, nor must the edges of the gold and the color touch, as the effect will be bad when fired. The *or Lacroix* (Lacroix gold), in powder or paste, is the safest to buy. Many professional decorators furnish excellent preparations of gold. It is always expensive, as to be good it must be pure. *Or en coquille* can be used over the painting after it has been fired. A similar gold is also prepared by Lacroix and sold in little bottles, and called *or liquide*, or liquid gold. Very pretty effects can be obtained by its use, but it will not bear much use or rubbing. It is really a lustre. It is best to put the gilding directly on the white porcelain, if possible.

When vessels of any kind are to be finished off with lines, either around their edges or between any bands of color, it is done upon a *whirling table*, or table-wheel something like a potter's wheel—a horizontal circular slab, so placed on a pointed iron rod as to spin or whirl easily and truly when turned by the hand, standing firmly on a base or foot, and solid so as to be steady when used. These, when good, are expensive; poor ones are worthless. The decorator, steadying his arm on his painting-rest, applies a brush full of color to any circular piece of ware, and moves the wheel round with his other hand—making as fine or as thick a line as may be required. The lines on pieces of any other shape must be done by hand, requiring great skill and practice.—all good professional decorators will do this work so well that it is better to trust it to them.

Hard-Kiln or Medium Heat Colors (read Chap. VIII., page 86).—These procelain colors are what decorators here call *hard* or *high fire colors*, baking at about 950° or more Cent., 1742° F., and are used overglaze. They must not be confounded with gloss-oven colors. Owing to their comparative infusibility, gilding and painting with the softer colors can be done on them as on a colored glaze. The colors are much the same, only fewer in number than the regular kiln colors. These colors, which ordinarily are used only for backgrounds, are not sold here prepared for amateurs, nor is there but a small choice of them to be obtained in this country. They can be obtained from professional decorators. The method of using them is the same as that for the regular kiln colors or ordinary porcelain paints. It is better to let the professional decorator put them on. For full details of the *méthode Richard*, see Chap. VIII. This method, which gives most lovely effects, cannot be used here, owing to the want of proper firers, and also because it can be successful only in the hands of very experienced painters.

Soft Porcelain—Artificial.—In Paris various soft porcelains are sold for decorative purposes, and occasionally a piece of old white Sèvres can be found in a curiosity shop, but the Sèvres manufactory does not make any ware for sale. The colors used in decorating soft porcelain are prepared especially for the purpose, and should be bought for the particular make of ware on which they are to be used. They are much the same as those used in hard porcelain, only fewer in number, the lead-glaze preventing the use of many colors. The flesh-reds cannot be used at all, and carmines have to be mixed with yellows and whites, to obtain such tints. White is much used in mixing, so it is important to have a good white. Bright, gay tints are easily obtained on soft porcelain; the difficulty is in obtaining rich sober tones. Both colors and porcelain can be obtained in Paris at the "Bon Broyeur," and also from most of the color makers mentioned on page 205 Their proper use can only be learned from a good teacher, and the firing must be conducted with the utmost care by a very good baker. When these conditions are fulfilled there is no particular difficulty in their use and the effect is very beautiful. It must be understood that these remarks do not apply at all to the painting in Lacroix or other colors on *English* soft or bone porcelain, of which the glaze is hard enough to bear any of the regular colors, but only to the French and other soft porcelains with very soft glazes.

Painting on Fine Earthenware *over* the *glaze.*—All the directions given for the use of paints on porcelain apply equally well to their use on this ware, except that the carmines may not be very bright. Be very careful in choosing this ware. Large plaques are sold which are excellent for bold decorative work. The best are marked "**H. B. Choisy,**" but are difficult to obtain here. Those from *Montereau*, also good, but having a bluer glaze, have various marks, the name Creil or Montereau being generally visible. These have a rather soft glaze, giving good effects when baked. It is better to have only one baking, though they will generally stand two very well. The Lacroix colors work perfectly well on both of the above, as will also the English colors. Good plaques and other pieces for decorative purposes are made at Trenton and elsewhere in this country. A certain cream-colored ware, sold only by Bedell in New York, is pretty, and is guaranteed not to craze; which was the fault of the first ware of that kind made here. It is safer to make experiments with all wares before beginning any important work. In the shops all these wares are often called faïence, and all sorts of shapes can be procured. In speaking of **Plaques,** the French decorators refer only to perfectly flat or slightly curved surfaces of any shape, and without a bottom rim or base. The round, shallow, somewhat saucer-shaped dishes here called plaques they call coupes.

Underglaze painting on the biscuit of earthenware, either fine or common.—In Europe amateurs do a good deal of this work, which offers no particular difficulties to any one knowing how to paint well. It is generally spoken of here in rather a vague way as **Painting on Biscuit.** The colors should suit the biscuit, and the glaze must suit the colors, or all will be ruined. The biscuit most easily managed is that of fine white ware. The granite has a fine grain, but takes too hard a glaze for many colors. If the biscuit is very porous, it is generally sized with gum-water or something of that nature; though sometimes this is not done, thereby enhancing the difficulty of the process. The colors, which must be obtained especially for this work, are mixed with water or gum-water, or with turpentine; if the latter, the ware must be brought to a red heat, in order to drive out the turpentine or oils, otherwise the glaze will not answer. This is called *hardening on*, and can be done in a decorator's muffle. It must be remembered that the colors cannot be rubbed out, as in overglaze painting. The colors as used look very unlike what they will appear when fired, so a good deal of practice is required, and a sufficiently accurate knowledge of drawing, to prevent mistakes. The colors, of course, are all gloss-oven, and in this case are really underglaze colors. The Lacroix colors sold in tubes and powder, and marked G. F. (*grand feu*) are intended for underglaze painting, and generally answer well enough.

The English, French and German firms spoken of, page 206, also make underglaze colors. Those most used in this country are prepared by Emery. They generally must be ground over before using. It must be remembered that these colors are useless for painting *on porcelain*, either biscuit or overglaze. After glazing, the work may be finished with overglaze colors or gilding. Experiments must be made in order to test the colors on the desired ware; such a test plate as that described for hard porcelain being the safest way. Other biscuits besides those mentioned may be used with good effect. A red biscuit is used successfully in England, but in this country as yet there are practically no facilities for firing and glazing such work. Almost any of the large potteries will furnish biscuit and colors, the latter wholesale, and are willing to bake the ware, subject to all sorts of risks on the part of the decorator. A sort of keramic crayons, made of coloring matter mixed with enough fatty or sticky substance to give them consistency, can also be used for decorating biscuit. The fatty matter is burnt away before glazing. These crayons were invented by a German, Mr. Müller. The drawing done by means of them should be in a very bold and sketchy style, either in large strokes or by hatching.

The decorated ware should be properly "*hardened on,*" as described, before being sent to the potter to glaze, or the painting will probably be spoiled. No doubt in time, perhaps even by next winter, there may be kilns in all the great cities where such work can be done, though the risk is always much greater than in overglaze work.

It may be of use to mention here that in many of the French works on pottery, and particularly in the smaller ones treating of decoration, the term **Faïence** when used alone means **Majolica,** or *tin-glazed earthenwares*, and the directions of any kind given in such works for painting or decoration on faïence apply only to this particular ware. In speaking of what in the shops here is generally called faïence, they call it faïence fine, faïence anglaise, cailloutage, or porcelainé opaque. As many of these works are translated without any clear definitions being given as to the wares and their English names, it is very puzzling for the beginner who has not a clear knowledge of the different kinds of pottery, and so cannot make out what is meant from the context. So far, the tin-glazed earthenwares have not been decorated to any extent in this country, and probably will not be for some time to come. The faïences fines, also called opaque porcelain, granite, ironstone ware, semi-porcelain, etc., are much used here, as nearly all the muffle colors can be used on them over the glaze.

Painting Over the Glaze of Tin-Glazed Earthenware is easy enough, and should be done in a bold and sketchy style. The colors used are much the same as the regular kiln colors. In Paris colors can be bought especially suited to the different makes of the earthenware; here it would be necessary carefully to test the colors first, and there would also probably be a difficulty in having the baking done properly. All the gold colors can be used, also many greens, yellows, and blues. For painting on, or rather *in*, the glaze, see page 88, Chap. VIII.

Email.—In French works this refers to paintings on little plaques of metal, covered with white enamel. They are baked in special ovens, and require special colors, also a thorough knowledge of painting and drawing. There are small oval plaques of porcelain sold here, and many people imagine they are the enamel plaques referred to in the books; hence some confusion. The porcelain plaques are to be treated as any hard porcelain, only, as a rule, the glaze on them is thicker than that on table ware.

No books whatever will take the place of a competent teacher, but after a student can do good work in his line all good books on the subject become a great assistance. There are a number of little manuals for keramic painters, which are nearly all good; those written by professional decorators always having useful recipes, and the others being generally compiled from good works. When read with understanding much can be gained from them, the principal difficulties of comprehension arising either from want of clearness in author or translator, or from the fact that many readers do not understand the qualities of the different wares and of the colors to which the writer refers. I hope that this little book will help to obviate such difficulties. Among the best of these manuals are those by Mme. Delamardelle, M. Goupil, John C. L. Sparkes, Miss McLaughlin (only for porcelain), and Mr. Camille Piton. The two latter, being written expressly for American students, are very good. The series of plates accompanying Mr. Piton's make excellent studies for beginners, particularly if they will condescend to follow the directions given by the author.

CHAPTER XVII.

A FEW ÆSTHETIC HINTS.

It is difficult, almost impossible, to tell any one just how to do good decorative work. The best that can be done is to give people some idea of what they may not do, and so warn them against things positively ugly. Owen Jones's "Grammar of Ornament" is considered an authority on decorative work, and it can be found in any large public library. The reader must beware of the coloring of the plates, this being glaring and crude, and not at all reproducing the harmonious tones of many of the objects represented. Racinet's "l'Ornement Polychrome" is good, but is not easily seen. M. Charles Blanc, one of the greatest of living writers on art, promises a "*Grammar of Decorative Art*" which if reproduced *in full* in English will be very valuable to keramic decorators. The introduction to Charles Blanc's "Art and Ornament in Dress:" (Scribner, 1877,) will also be found very suggestive, and should be read carefully. It is a pity it is not published in a separate pamphlet. This book is part of the above-mentioned work which is not yet completed

Many of the Kensington Museum handbooks may be read with advantage. **Zeigler's** "*Études Céramiques*" is a mine of valuable suggestions to the keramist. It is the work of a historical painter who became a keramist, and made wares noted for excellence of quality and beauty of decoration. As far as I know it can only be seen at the Astor library, New York.

I subjoin a set of rules, or rather remarks by M. Charles Blanc, published in the "Gazette des Beaux Arts" (beginning March 1st, 1875), in an article devoted to the decoration of vases which follows one on "The Form of Vases," or perhaps, we should say, of pottery. These rules are excellent, being brief and simple, and in many respects are broader in scope than the better-known ones of Owen Jones.

Many of Owen Jones's precepts are puzzling, and some are very arbitrary, and even useless, particularly for the keramic artist, who is not troubled with any considerations of construction in his homogeneous and plastic material. I also give some excellent rules used in the South Kensington Schools, in London.

Blanc "On the Decoration of Vases."— [Keramic Decoration.]

1. In keramic art, as in all other arts, decoration should be subordinate to the form of the object decorated.

2. Perspective effects are out of place in the decoration of vases [or of any rounded surfaces.]

3. Picture painting should not be imitated in vase

painting, as this last, contrary to the rules of the former, delights especially in pure clear colors and unbroken tones.

4. Instead of the exact imitation of nature, keramic decoration, even in the copying of natural objects, subordinates imitation to the laws of harmony, and to the delight of the eye and of the mind.

5. Keramic decoration instead of striving after absolute unity of tone and the perfect evenness of surfaces [or color], should try to break these, either by vibration of color, or by one of the numerous means at the service of art, in order to bring play (*jeu*), and as it were variety even into monochrome. [This is a most **Important Rule** for the decorator. In much ware here and in Europe the decorator seems to endeavor to make the color as absolutely flat and even as possible, an effect easily obtained by powdered backgrounds. In the best Eastern and other work, we see the surface, even of a plain color, broken up in some way; the color being often put on in several layers, or very slightly mottled or uneven. In other cases there is a slight pattern over it. Perfectly even and monotonous tones are to be avoided. At a distance the tone may look even, but a near approach should show a sort of shimmer or vibration, which is a source of unending pleasure. The careful study of the petals of flowers will suggest much to an observant person; those apparently the most even in tone will be found to possess this property.]

6. The rules (convenances) of keramic art vary ac-

cording to the destination of the object decorated, ware for daily use not receiving the same decoration as wares for show and ornament. [In common household wares all useless knobs, excrescences or depressions should be avoided, as they break easily, or else catch the dust; and however pretty their effect may be, the good housekeeper soon learns to avoid them. Household ware must, above all, look clean. The color decoration of such ware had better be quietly gay. In wares for ceremonious or state occasions, the keramist's fancy may have fuller play, but even then the *destination* of the plate or cup must be continuously borne in mind. Objects of pure ornament, to be placed on shelves or buffets, will offer full scope to the keramist, who nevertheless should still keep a tight rein on his fancy.]

7. When, as is necessarily the case in ornamental keramics, the form of the vase is symmetrical, it is not necessary that symmetry should be apparent in the decoration. [The Japanese are masters of what Blanc calls *balanced confusion.*]

8. The most beautiful color decoration of vases is by no means that which multiplies various tints, but rather that which, taking two complementary colors which mutually heighten each other, or two contrasting colors, tempers and harmonizes them by some intermediate accessory, and by less showy tones.

9. Although the imitation of gems, of beautiful

stones, of bronze, has produced both curious and interesting results, the keramic decorator will do well to avoid all such counterfeiting, and to rest content with the wide field offered by the resources peculiar to his art.

10. Ornament in high relief is unsuited to keramic decoration. Modelled figures trenching on the sculptor's art are unsuited to the glazed parts. (A l'ornement de la céramique ne conviennent point les hauts reliefs, non plus qu à la partie émaillée les figures de ronde bosse en tant que ces figures appartiennent à la sculpture d'art.)

Blanc also says, in this agreeing with Lessing, whose Laocöon is an excellent work for art students to read: "We have here still another proof of the truth that it is dangerous for one art to enter the domain of another, and just as nations lose their peculiar physiognomy as they approach their frontiers, so an art becomes weakened when it approaches the confines of its proper domain, and corrupted when it passes them."

South Kensington Rules.—1. The form should be most carefully adapted to use, being studied for elegance and beauty of line, as well as for capacity, strength, mobility, etc.

2.—In ornamenting the construction, care should be taken to *preserve the general form*, and to keep the decoration subservient to it by the low relief or otherwise; [compare with Blanc, rule X.] the ornament should be so arranged as to enhance, by its lines, the symmetry of the original form and assist its constructive strength.

3.—If arabesques or figures in the round are used, they should arise out of the ornamental and constructive forms used, and not merely applied.

4.—All *projecting parts* should have careful consideration to render them as little liable to injury as is consistent with their purpose.

5.—It must ever be remembered that repose is required to give value to ornament, which in itself is secondary, not principal.

Two other good precepts are:

1.—Let every line of the design have meaning.

2.—Use the fewest possible lines to convey the meaning.

The following are the most useful rules given by **Owen Jones** for keramic decoration, the other rules referring more especially to architecture, and to textile fabrics.

Rule 5.—Construction should be decorated. Decoration should never be purposely constructed.

Rule 6.—Beauty of form is produced by lines growing out, one from another in gradual undulations. There are no excrescences. Nothing could be removed and leave the design equally good or better.

Rule 7.—The general forms being first cared for, these should be subdivided and ornamented by general lines; the interstices may then be filled in with ornament, which may again be subdivided and enriched for closer inspection.

Rule 9.—As in every perfect work of architecture a true proportion will be found to reign between all the members which compose it, so throughout the decorative arts, every assemblage of forms should be arranged in certain definite proportions. *Those proportions will be most beautiful which will be most difficult for the eye to detect.* Thus the proportion of a double square, or 4 to 8, will be less beautiful than the more subtle ratio of 5 to 8, 3 to 6 than 3 to 7, 3 to 9 than 3 to 8, 3 to 4 than 3 to 5. [For a very interesting exposition of this see Ruskin, "Modern Painters."]

Rule 11.—In surface decoration all lines should flow out of a parent stem. Every ornament, however distant, should be traced to its root and branch (oriental practice). [*This, which is excellent, only applies to certain classes of ornament.*]

Rule 12.—All junctions of curved lines with curved, or curved lines with straight, should be tangential to each other (natural law—oriental practice in accordance with it). [*This is a good and important rule, and means that such lines should sink gradually and imperceptibly into each other, and not as if they were abruptly crossing each other.*]

Rule 14.—Color is used to assist the development of form, and to distinguish objects or parts of objects from each other. [True generally, but in much fine keramic work, color is simply the delight of the eye, and means nothing at all. Much beautiful Eastern work is of this nature, and delights us by its harmonious intermingling of rich hues.]

The above are the most useful rules.

There is not much to be said about **Construction** in keramic art, for, owing to the plastic nature of the material, almost any shape is allowable; only for useful objects it should be *suitable*, and for ornamental ones should be either *beautiful* or *pleasing*, and in this last category may be placed many *quaint* and *grotesque* forms that charm us by their oddity. As to **Color Decoration** it should *always* be *beautiful*, or at the least *agreeable*. Ugly decoration should not exist. Crude, raw, inharmonious color is inexcusable in this branch of art. Rich soft color will cover all defects, and often vessels having every fault are saved by beauty of color, while the most perfect drawing and design will never reconcile us to ugly color. This should always be borne in mind. Much agreeable and simple decoration is done by the use of black and white, or of other very quiet combinations. The Japanese excel in this, and the beauty and pleasantness of such work will be found to depend on the suitability of even such simple shades to one another. For example, intense black and intense white are not agreeable in large masses, but are so when broken either by making the black greyish in actual tone, or by subdividing it. Exquisitely delicate work is done with gold or silver on white grounds.

The earnest worker in decorative art will also do well to study all the *good* Eastern work he can see, and will try to understand its soft and rich harmony of color, the careful balancing of parts, and above all the honesty and truth of the work; not trying so much to *imitate* it as to seize and make use of its underlying principles. Some modern work is civilized out of these fine qualities, but there is still plenty of good work done in the East.

Following and supporting these views, I can give nothing better on the subject than an extract from the last chapter of "Modern Chromatics" by Ogden S. Rood. The whole chapter, which, unfortunately, is too long to quote in full, should be read by all would-be decorators, and the whole book may be studied with great profit:

"The aims of painting and of decorative art are quite divergent, and as a logical consequence it results that the use made by them of color is essentially different. The **Object of Painting** is the production, by the use of color, of more or less perfect representations of natural objects. These attempts are always made in a serious spirit, that is, they are always accompanied by some earnest effort at realization. If the work is done directly from nature, and is at the same time elaborate, it will consist of an attempt to represent, not all the facts presented by the scene, but only certain classes of facts, namely, such as are considered by the artist most important or most pictorial, or to harmonize best with each other. If it is a mere sketch, it will include not nearly so many facts; and finally, if it is merely a rough color-note, it will contain perhaps only a few suggestions belonging to a single class. But in all this apparently careless and rough work the painter really deals with *form*, *light* and *shade*, and *color*, in a *serious* spirit, the conventionalisms that are introduccd being necessitated by lack of time, or by choice of certain classes of facts to the exclusion of others. The same is true of imaginative painting; the form, light and shade, and color are such as exist, or might be imagined to exist; our fundamental notions about these matters are not flatly contradicted. From this it follows that the painter is, to a considerable extent, restricted in the choice of his tints; he must mainly use the pale unsaturated colors of nature, and must often employ color combinations that would be rejected by the decorator. Unlike the latter, he makes enormous use of gradation in light and shade and in color; labors to express distance, and strives to carry the eye beneath the surface of his pigments; is delighted to hide as it were his very color, and to leave the observer in doubt as to its nature.

"In **Decorative Art,** on the other hand, the main object is to *beautify a surface by the use of color rather than to give a representation of the facts of nature.* Rich and intense colors are often selected, and their effect is heightened by the free use of gold and silver or white and black. Combinations are chosen for their beauty and effectiveness, and no serious effort is made to lead the eye under the surface. Accurate representations of natural objects are avoided, conventional substitutes are used; they serve to give variety, and furnish an excuse for the introduction of color, which *should be beautiful in itself apart from any reference to the object represented.* Accurate realistic representations of natural objects mark the decline and decay of decorative art. A **Painting** is a representation of something that is *not present;* an **Ornamented Surface** is essentially *not* a representation of a *beautiful absent object*, but is the *beautiful object itself;* and we dislike to see it forsaking its childlike independence, and attempting at the same time both to be and to represent something beautiful. Again, ornamental color is used for the production of a result which is delightful, while in painting the aim of the artist may be to represent sorrow, or even a tragic effect. From all this it follows that the ornamenter enjoys an amount of freedom in the original construction of his chromatic composition which is denied to the painter, who is compelled by profession to treat nature with at least a fair degree of seeming respect. The general structure of the color composition, however, being once determined, the fancy and poetic feeling even of the decorator are compelled to play within limits more narrow than would be supposed by the casual observer. It is not artistic or scientific rules that hedge up the path, but his own taste and feeling for color, and the desire to obtain the best result possible under the given conditions. In point of fact, color can only be used successfully by those who love it for its own sake apart from form, and who have a distinctly developed color-talent or faculty; training or the observance of rules will not supply or conceal the absence of this capacity in any individual case, however much they may do for the gradual color-education of the race.

"From the foregoing, it is evident that the positions occupied by color in decoration and painting are essentially different, color being used in the latter primarily as a means of accomplishing an end, while in decoration it constitutes to a much greater degree the end itself. The links which connect decoration with painting are very numerous, and the mode of employing color varies considerably as we deal with pure decoration, or with one of the stages where it begins to merge into painting."

In a small book by Miss E. W. Johnson, called "Studio Arts" (N. Y., 1878), can be found a good sketch of the rules of contrast of color according to Chevreul. Rood's "Modern Chromatics" gives all the modern theories, many of which have only an interest of curiosity for the artist.

Many writers maintain that no *pictorial* work should be done on pottery of any kind. Others maintain that flat plaques and tiles are as suitable as wood or canvas for pictures, especially as the technical working difficulties grow less and less every day, and the pottery possessing the advantage of being practically imperishable will preserve forever the copies or the originals of pictures. It would certainly be pleasant to possess a plaque by or after Apelles.

APPENDIX.

BOOK LIST.

I here give a list of some of the best works on keramics. The literature is very large, and is increasing every day. Most of the works, excepting those on special subjects, are repetitions of Jacquemart and Brongniart.

General Historical Treatises.

JACQUEMART, ALBERT.—"The History of Ceramic Art," translated from the French by Mrs. Bury Palliser. A descriptive philosophical study of the pottery of all ages and nations, profusely illustrated. This is considered the standard work on the subject; is expensive. "Merveilles de la Céramique," by the same, is much like the above, but shorter and with fewer illustrations. Has not been translated; is not expensive.

TREADWELL.—"Manual of Pottery," very good.

MARRYAT, JOSEPH.—"History of Pottery and Porcelain" (from 15th to 18th century). Excellent as far as it goes, and well illustrated. The best edition is the French translation, annotated by

Count d'Armaillé and A. Salvétat (Paris, 1866).

CHAFFERS, W.—"Keramic Gallery." Besides historical notices and descriptions, it gives several hundred photographs.

PRIME, WILLIAM C.—"Pottery and Porcelain of all Times and Nations."

YOUNG, JENNIE.—"The Keramic Art."

ELLIOTT, CHARLES WYLLYS.—"Pottery and Porcelain."

The last three have good chapters on American pottery, ancient and modern.

JAENICKE, FRIEDRICH.—"Grundris der Keramik in bezug auf das Kunstgewerbe." This is also a fine work, and will be found very interesting.

Manufacture.

The following books treat more particularly of the processes of manufacture of pottery, only incidentally touching keramic history.

BRONGNIART, ALEXANDRE.—"Traité des arts céramiques" (2 vols and atlas, Paris). This is the best book on everything connected with the manufacture of pottery, and of the materials employed in its decoration. It gives recipes for the manufacture of all wares and their glazes, for colors, etc. It also gives histories of the different wares, and full historical tables. It is the foundation of nearly all the other works on pottery. There are three editions, the last being of course the best: that of 1844, which is found in all the large public libraries; that of 1856, not to be found in the libraries here;

and that of 1876. This last edition is enlarged and annotated by Salvétat, and can be found in the Philadelphia Library. The last edition has never been translated. It is an expensive book. The average reader will find sufficient technical information in articles in any good encyclopædia. The fact must be remembered, however, that most of the encyclopædias give only the English methods of manufacturing pottery, and so are not always correct in their remarks upon tin-glazed earthenwares and hard porcelains.

FIGUIER, LOUIS. — "Merveilles de l'Industrie." The first volume of this work is very fully illustrated as regards the manufacture, and the art history of glass and pottery.

TURGAU.—"Les grandes usines de France." See also the Roret manuals, "Porcelanier, faïencier et potier de terre."

ARNOUX.—"Bevans Brit. Manufacturing Industries" (vol. iii.). Very good and clear.

SHAW, SIMEON.—"Chemistry of Pottery" (London, 1837).

TENAX, B. P. (B. Prössel).—"Die Steingut und Porzellan Fabrikation" (Leipsic, 1879). Excellent, but purely technical.

Decoration and Art.

ZEIGLER.—"Etudes Céramiques" (Paris, 1850). This is a very fine work, valuable as coming from a man who is both artist and potter.

ROOD, OGDEN N.—"Modern Chromatics." This gives excellent advice to decorators. See Chapter XVII. for other works on decoration.

Marks and Monograms.

CHAFFERS, W.—"Marks and Monograms," which contains also an historical essay on English pottery, with illustrations. See also his "Collector's Handbook," a supplement to the above-mentioned work.

HOOPER and PHILLIP'S "Manual," a dictionary of easy reference.

DEMMIN.—"Guide de l'amateur de faïence," a comprehensive, illustrated work of high authority, with a good list of books.

French Pottery.

MARESCHAL.—"Faïence populaire au 18 me siécle" (Paris, 1872).

POTTIER.–"Histoire des faïences de Rouen" (1870).

POUY.—"Les faïences d'origine Picarde" (1872).

FORESTIE.—"Les anciennes fafenceries de Montauban."

DU CLAUZIOU.—"Poterie Gauloise."

Italy—Germany—Spain.

PASSERI.—For majolica see his history, treating of Pesaro and Urbino.

DELANGE.—For majolica and Italian faïence.

FORTNUM.—"Majolica."

BECKWITH.—"Majolica and Fayence" (New York, 1877). A concise and useful treatise, with numerous photo-engraved illustrations.

English Pottery.

BINNS, R. W.—"A Century of Potting in Worcester" (London, 1877). A very interesting work.

JEWETT.—"The Keramic Art of Great Britain from pre-historic times down to the present day" (London, 1877). A thorough and excellent work; the technical details are full and clear.

METEYARD, ELIZA.—"Joseph Wedgwood and his Works" (London, 1873).

China and Japan.

JULIEN, STANISLAS.—"Histoire et fabrication de la porcelaine Chinoise, traduit du Chinois" (Paris, 1856). This is the standard Chinese work on the subject, and is very curious and interesting. It can be found in most of the public libraries in the large cities.

————"Chinese Art Objects in the South Kensington Museum." One of the excellent handbooks of the South Kensington series.

JARVIS.—"Glimpse at the Art of Japan." See also "Reports and Awards," Group 3, Centennial Exhibition, 1876.

Ancient Pottery.

BIRCH. "History of Ancient Pottery." This treats of Assyrian, Egyptian, Greek, Roman, Etruscan, Celtic, Teutonic, and Scandinavian pottery, and is fully illustrated. It also contains a list of the principal collections of ancient pottery.

————"Antiquités Etrusques, Grecques et Romaines, tirées du cabinet de M. Hamilton" (3 vols). This is a finely illustrated work, with French and English text. There is a copy of it in the Philadelphia Library.

There are many more works on this subject, but they are nearly all rare and expensive, and can be seen only in public libraries, where lists of them can be obtained. Birch is the best for general readers.

Jacquemart is the best book for a person wishing to buy only one large work on the subject of general keramics. If that is too expensive, Prime, Young, or Elliott will answer. Full lists of books are given in Chaffers's "Marks and Monograms," which is a standard work for collectors. Prime and Elliott also give excellent book-lists, as does Mr. Nichols in his book entitled "Pottery—How it is made." Brongniart, Salvétat, and Ebelmen are chemists who have paid especial attention to keramics, and besides their large works, all of which are excellent, have contributed valuable articles to the "Bulletin de la Société d'encouragement pour l'industrie nationale," the "Annales de chymie et de Physique," and other journals. The "Gazette des Beaux Arts," contains a great number of excellent articles on keramics; the subject being treated from an historical and artistic standpoint. Many of the above-mentioned works can be procured from the Boston Public Library, which in some cases will send books to persons wishing to consult them. The Society of Decorative Art of New York has a list of books that may be borrowed on certain conditions.

APPENDIX B.

NOTES.

1. (Page 35.)

Piedmontese and Spanish porcelain, see pages 49, 145. This is very tough, and stands fire so well that it seems worth while making it for dishes, jugs, etc., in which food can be cooked or heated. It takes color decoration perfectly well, but is greyish in tone.

2. (Page 38.)

Paste, body. These terms are synonymous, body being, however, the term most used by potters, while paste is generally used in books.

3. (Page 65.)

In Germany the workmen use dipping hooks when slushing or dipping some fine wares into the glaze-liquid. These are a sort of rings with sharp projecting points; dipping tongs are also used. Skill and practice are required in this method, which offers great advantages. The result is excellent, as the glaze is evenly distributed over the surface, and there are no finger marks to be pencilled over.

4. (Page 66.)

For descriptions of the very latest improvements in kilns and muffles, see a book by B. P. Tenax (B. Prössel). See book-list for full title.

5. (Page 68.)

It is only in comparatively recent times that coal has been much used in baking porcelain in France. When coal is used, the wads or rolls of clay between the seggars must be very carefully arranged so that the seggars are perfectly tight; for if coal ashes penetrate into them, any iron in the ashes is apt to cause brownish spots on the wares. The biscuit baking, too, must be conducted with great caution, and the pieces placed as carefully as for the final firing. Experiments made at Sèvres seem to prove that where the smoke, etc., comes in direct contact with the biscuit, it is almost certain to warp in the high fire. It is thought possible that something in the smoke softens the paste. Coal also affects the high fire or gloss-oven colors in various ways. Céladon and chrome greens are improved in tone. Blue is harder to manage than with wood, but with an oxidizing fire, or letting a free current of air circulate through the kiln so that all vapors or gases are consumed, blue succeeds well. When by the use of coal and wood combined, or by other means, the potter is able at will to make his fire either reducing or oxidizing, many beautiful effects can be obtained. For example, the oxide of uranium, about 5 parts oxide to 95 hard porcelain paste, baking in an oxidizing fire (with a full draught or plenty of air), gives a beautiful light, slightly greenish-yellow. With a reducing fire, it is greyer in tone. In a neutral fire, the color is a light greenish-grey. In a very reducing fire, fine reddish, brown or black tints can be obtained by augmenting the quantity of oxide. When oxide of zinc is used in colors the fire must be reducing, or the colors will be spoiled.

6. (Page 73.)

Colored pastes, see notes 5 and 8. Very beautiful pinks are now obtained from the aluminate of chrome. This is used in the preparation of the celebrated pâte changeante.

7. (Page 75.)

Potters should bear in mind that wares for purely decorative purposes, such as plaques or vases, are to fulfil entirely different conditions from wares designed for use. Beauty is the only consideration in purely ornamental ware, and experience demonstrates that such wares are best made with the soft glazes which are very objectionable in useful or household wares. The paste and glaze of such wares should contain no cobalt nor stain of any kind. If there is an excess of soda in the glaze, it is apt to boil or "spit," as it is called; this is often the case when the glaze is made too soft by borax.

8. (Page 76.)

Pâte-sur-pâte. Great care must be taken in coloring porcelain bodies, as many colors affect the fusibility of paste to a marked degree. The coloring matter must be, either: 1. more fusible than the paste, 2. less fusible, 3. equally fusible. In the first case, more kaolin must be added to harden the paste, in the second more feldspar or other fusible element. When paste and coloring matter are of equal fusibility, it will still be found necessary to make careful experiments, for two colored pastes that may answer perfectly well separately may be ruined by mixing them. Careful tests must also be made so as to insure the equal contraction, etc., of the paste. All this also applies to porcelain pastes, thin or thick, used as colors or paints. Very strong effects can be obtained by using the coloring oxides pure or fluxed as for underglaze painting, but without paste or slip. The above remarks apply to slip-painting on all wares. On earthenwares or on soft porcelains the colors are much easier to prepare on account of the softer glaze, and of the lower degree of heat required in firing.

9. (Page 90.)

Developing colors. Firemen in this country generally know or care little or nothing about the artistic value of color. A good fireman and placer should know how to bring out the full beauty of a color, neither under nor over firing it. In firing amateurs' work, it might be well for the fireman to inquire what colors have been used in an important piece of work, and even to ask for a test piece before baking a valuable painting. German muffle colors require a very hard fire, while on the other hand the English colors require a comparatively low fire. The French colors are between the two. Muffles with sloping sides, so that the cross section is coffin-shaped, are considered excellent. Muffles must be kept as clean as possible, and, in order to keep out the sand and dirt, may be washed out with fresh lime after at least every second firing. Iron grids or shelves should never be used, as when above red-heat the emanations from them injure the colors. Fire-clay, or still better, porcelain biscuit grids, well washed, should be used. All finely painted ware should be most carefully placed. In no case should stilts or supports of any kind rest on the painting. Firemen in this country, not being trained to appreciate the artistic value of ware, are often very careless in such matters, and I have seen fine work utterly ruined in this way, for no matter how delicate the points of contact, the melted color or glaze is torn away. Flat ware should be placed with rings, thimbles, pins and covers, instead of with stilts. In this way it takes up but little room, and can be easily placed in the muffle, is protected from dust, and the important decoration is not touched at all. Should this method not be available, the fireman, or rather placer, must use his ingenuity to guard the painting against damage. In all cases a cover can be arranged over a fine painting. The above suggestions apply equally well to underglaze decorations, for the same precautions should be taken in placing ware in seggars. Each very fine painting should have its own seggars, and decorators should be willing to incur the extra expense involved in extra precautions. Soft glazes must be handled very carefully. All decorated ware should be carefully dried before baking, and should not be placed in the muffle until the surface is perfectly dull, with no shine at all. If this is done in a drying stove, the stove should be heated very slowly. If the drying is done properly, the colors are much more brilliant when baked.

10. (Page 93.)

Silvering. The silvering done on some decorated porcelains is preserved from the action of the air by means of a very thin coat of gold over it.

11. (Page 98.)

Classification. Salvétat's tables of classification are here given in full, with no changes except in the arrangement of the species or glazes which he arranges in chronological order, while in his tables as here given, they are, for convenience sake, arranged according to their composition. Many new examples and notes are added. The terms lime-body, magnesia-body and petrosilex-body are suggested. The former two are of little consequence, but petrosilex seems applicable to certain Japanese and Chinese porcelain bodies. The term feldspar-body might seem equally appropriate, but the fact must be remembered that the names of the bodies indicate the characteristic ingredient in the paste, not the principal element in the chemical analysis. If the investigations mentioned in Chap. XIV. are correct, Japan and perhaps China are the only countries in which a petrosilex is used as the principal ingredients of a porcelain body, while a paste almost all feldspar, with only a little bone phosphate, has long been used for buttons, and artificial teeth. American potters are enterprising, and doubtless if it is worth while can find petrosilicious minerals here, that will make as beautiful a ware as the Japanese.

12. (Page 119.)

Common tin-glazed ware. Tin-glazed ware has never been made nor used to any extent, either in this country or in England, but is much used in continental Europe. Ware much resembling it in appearance is made here, as described on page 121. Some of it is very pretty in shape and outside color, and when lined with a white slip, and glazed, is practically the same ware as the mezza-majolica described on page 122. This last is a good example of the value fine artistic decoration may give to the commonest pottery. The name "enamelled," or "porcelain-lined," sometimes given by dealers to these wares is misleading, particularly the latter, as it is obvious that a ware baking at a low temperature cannot be lined by one baking at a high heat.

13. (Page 177.)

Lacroix colors. Many of the colors sold by Lacroix and other French makers are bought in England, are ground over again, fired in the biscuit kiln, and then ground again, the process being sometimes repeated several times. The superiority of many French colors lies more in the mechanical than in the chemical preparation.

INDEX AND GLOSSARY.

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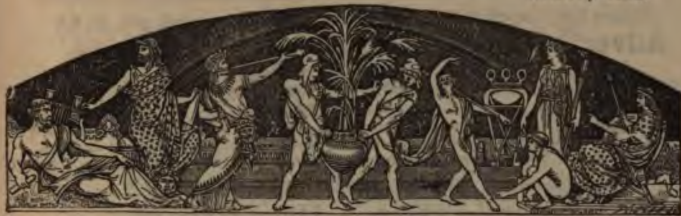

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